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Simulation Modeling of the Shallow Ground-Water System in Las Vegas Valley, Nevada

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SIMULATION MODELING OF THE SHALLOW GROUND-WATER SYSTEM IN LAS VEGAS VALLEY, NEVADA

by

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Grant Number R800946

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Since the vast influx of population began pouring into the Las Vegas Valley in the 1940's the hydrologic regime of the Valley has undergone significant change. The pristine environment of the Valley was desert with desert vegetation and no perennial flow out of the Valley. With increase in population came the proliferation of lawns, shrubs, and trees throughout the Valley. This domestic irrigation of vegetation together with waste-water return flows has caused a perennial stream leaving the Valley through Las Vegas Wash. This study was implemented to determine what is happening in the shallow ground-water zone (0 to 300') within the Valley, its flow, and the main sources of contamination. Results of this study have been divided into three volumes. The first volume deals with the problem of how ground-water quality is affected by land and water use throughout the Valley. Volume two entitled, "Las Vegas Valley Water Budget: Relationship of Distribution, Consumptive Use, and Recharge to Shallow Ground Water," gives a detailed picture of the input and outflow of water being used in Las Vegas Valley. This publication, the third volume, "Simulation Modeling of the Shallow Ground-Water System in Las Vegas Valley," discusses the problems and water level fluctuations in the shallow ground-water system.

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FOREWORD

Since the vast influx of population began pouring into the Las Vegas Valley in the 1940's the hydrologic regime of the Valley has undergone significant change. The pristine environment of the Valley was desert with desert vegetation and no perennial flow out of the Valley. With increase in population came the proliferation of lawns, shrubs, and trees throughout the Valley. This domestic irrigation of vegetation together with wastewater return flows has caused a perennial stream leaving the Valley through Las Vegas Wash. This study was implemented to determine what is happening in the shallow ground-water zone (0 to 300') within the Valley, its flow, and the main sources of contamination. Results of this study have been divided into three volumes. The first volume deals with the problem of how ground-water quality is affected by land and water use throughout the Valley. Volume two entitled, "Las Vegas Valley Water Budget: Relationship of Distribution, Consumptive Use, and Recharge to Shallow Ground Water," gives a detailed picture of the input and outflow of water being used in Las Vegas Valley. This publication, the third volume, "Simulation Modeling of the Shallow Ground-Water System in Las Vegas Valley," discusses the problems and water level fluctuations in the shallow ground-water system.

These three volumes represent an assessment of the shallow ground-water system in Las Vegas Valley and should be of use to anyone dealing with that aspect of the hydrologic regime in Las Vegas Valley.

Gilbert F. Cochran
Acting Executive Director

ABSTRACT

The hydrogeologic study of the shallow ground-water zone in Las Vegas Valley, Nevada determined the sources and extent of ground-water contamination to develop management alternatives and minimize adverse effects. An extensive, computerized data base utilizing water analyses, well logs, head measurements, and surface flows was developed. In an arid region, knowledge of the behavior of the individual components of the hydrologic system, especially ground-water components, as well as their interrelationships, is highly critical. In the Las Vegas Valley, these interrelationships are especially important, but have not been closely studied until recently. The shallow ground-water system of the Valley represents an important component of the system, and an understanding of it is requisite to the efficient use of water resources in the Valley. This system is composed primarily of clay and silt with interstratified sands, gravels, and caliche, although the deposits in the southern part of the Valley are more permeable. A two-dimensional steady-state digital computer model of this system was constructed by dividing the Valley into four sub-areas. The model treated the system as an unconfined one, although there is evidence of local confinement. The results of the modeling effort were not entirely successful, although results were better in certain areas than in others. Inadequate data, especially regarding boundary conditions and aquifer parameters, were responsible for the poor results. However, the efforts will prove useful in present hydrologic investigations as well as future sampling programs and modeling attempts.

This report was submitted in fulfillment of Grant No. R800946 by Desert Research Institute under the sponsorship of the U.S. Environmental Protection Agency. This report covers the period November 1, 1969, to January 31, 1974, and work was completed as of May 31, 1977.

CONTENTS

Foreword . . . iii
Abstract . . . iv
Figures . . . vi
Tables . . . xiii
Metric-English Conversions . . . ix
Acknowledgment . . . x

1. Summary, Conclusions and Recommendations . . . 1
    "Near surface" flow system . . . 1
    Simulation modeling results . . . 1
    Recommendations . . . 3

2. Introduction . . . 5
    Physical setting . . . 5
    Principal features of shallow ground-water occurrence and use . . . 7
    Principal aquifer zones . . . 10
    Recharge-discharge relations . . . 11

3. Hydrology of the Near Surface Zone . . . 13
    Background for the modeling concept . . . 13
    Specification of boundary conditions . . . 15
    Water budget . . . 31
    Flow models . . . 38

Bibliography . . . 57
Appendix 1 - Nodal recharge and discharge values as used in simulation models . . . 60

Part 1. Northwest Subarea - recharge in gal/min . . . 65
Part 2. Southwest Subarea - recharge in gal/min . . . 103
Part 3. Northeast Subarea - recharge in gal/min . . . 147
Part 4. Northwest Subarea - discharge by pumpage of private wells (1972 only) . . . 187
Part 5. Southwest Subarea - discharge by pumpage of private wells (1972 only) . . . 189
Part 6. Northeast Subarea - discharge by pumpage of private wells (1972 only) . . . 193
Part 7. Northeast Subarea - discharge through consumptive use by phreatophytes (1972 only) . . . 196

FIGURES

Number		Page
1	Location map showing Las Vegas Valley	6
2	Generalized east-west hydrologic cross-section showing ground-water occurrence and flow prior to extensive development	8
3	Principal features of ground-water occurrence and development	9
4	Photograph of Whitney Mesa as viewed from Gibson Road and Lake Mead Highway near Henderson, Nevada	17
5	Photograph of scarp in the vicinity of Las Vegas as viewed from the City of Las Vegas wastewater treatment plant	17
6	Photograph of scarp in the vicinity of Goldfield Avenue, North Las Vegas	18
7	Photograph of excavation for Las Vegas Expressway near Valley View Boulevard showing caliche and fine grained sediments	18
8	Photograph of excavation for West Charleston Reservoir near Buffalo Drive	19
9	Idealized geologic cross section A-A' from the West Charleston Boulevard area to Nellis Air Force Base	20
10	Idealized geologic cross section B-B' from the West Charleston Boulevard area to downtown Las Vegas	21
11	Idealized geologic cross section C-C' from Las Vegas Boulevard South (the "Strip") to downtown Las Vegas	22
12	Plot of percent aquitard materials at selected depths, west of the scarp between Salem Drive and Rancho Road	24
13	Map of estimated elevation of the bottom of the "near surface" zone	25
14	Water table map of the "near surface" zone, with an outline of the ground-water flow model areas	28

FIGURES

Number Page

15 Water budget for Las Vegas Valley, 1973 33

16 Hypothetical flow system with hydraulic potentials specified on all boundaries and a conductivity ratio of 10:1 horizontal to vertical 40

17 Hypothetical flow system with hydraulic potentials specified on all boundaries and a conductivity ratio of 1000:1 horizontal to vertical 40

18 Hypothetical flow system with hydraulic potentials specified on ends and water table, leakage specified on the bottom boundary, and conductivity ratio of 10:1 horizontal to vertical 42

19 Hypothetical flow system with hydraulic potentials specified on ends and water table, leakage specified on the bottom boundary, and conductivity ratio of 1000:1 horizontal to vertical 42

20 Histograms of estimated hydraulic conductivity by subarea and locations of data points 43

21 Steady-state simulation of water-level elevations in the shallow flow system, Southeast sub-area 49

22 Hydrograph showing Las Vegas Wash discharge in 1970 51

23 Simulated water levels in the shallow flow system at an elapsed time of 194 days 52

24 Simulated water level changes in the shallow flow system at an elapsed time of 194 days 52

25 Simulated water levels in the shallow flow system at an elapsed time of 2 years 53

26 Simulated water level changes in the shallow flow system at an elapsed time of 2 years 53

27 Simulated water level changes in the shallow flow system at an elapsed time of 6 years 54

28 Cross section of the shallow flow system showing simulated steady-state water levels, top of the low-yield sediments, and hydraulic potentials in the low-yield sediments 56

TABLES

Number		Page
1	Percent Aquitard Material Associated with Terms Appearing in Drillers' Logs	23
2	Comparison of Reported Water Levels in Wells of Different Depths in the West Charleston Boulevard Area	27
3	Golf Course Irrigation Using Potable Water in Las Vegas Valley, 1973	36
4	Comparison of Pumpage from Deep Aquifers and Recharge to the "Near Surface" Zone in West and Northeast Parts of Las Vegas Valley	38
5	Flow in Las Vegas Wash, 1969-1970	51

METRIC-ENGLISH CONVERSION*

A. LENGTH:

Unit	Equivalent(a) (b)					
	millimeter	inch	foot	meter(c)	kilometer	mile
millimeter	1	0.039 37	0.003 281	0.001 000	1 E-6	0.621 4 E-6
inch	25.40	1	0.083 3	0.025 40	25.40 E-6	15.78 E-6
foot	304.8	12	1	0.304 8	304.8 E-6	189.4 E-6
meter(c)	1 000	39.37	3.281	1	0.001	621.4 E-6
kilometer	1 000 000	39 370	3 281	1 000	1	0.621 4
mile	1 609 000	63 360	5 280	1 609	1.609	1

*Footnotes for all parts of Table 5

(a) Equivalent values are shown to 4 significant figures.

(b) Multiply the numerical amount of the given unit by the equivalent value shown (per single amount of given unit) to obtain the numerical amount of the equivalent unit (e.g.: 5 inches × 0.025 40 m/inch = 0.127 0 m).

(c) This is the SI expression, in base units or derived units, for the physical quantity.

B. AREA

Unit	Equivalent(a) (b)						
	sq. inch	sq. foot	sq. meter(c)	acre	hectare	sq. kilometer	sq. mile
sq. inch	1	0.006 944	645.2 E-6	0.159 4 E-6	64.52 E-9	645.2 E-12	249.1 E-12
sq. Foot	144	1	0.092 90	22.96 E-6	9.290 E-9	92.90 E-9	35.87 E-9
sq. meter(c)	1 550	10.76	1	247.1 E-6	1 E-4	1 E-6	386.1 E-9
acre	6 273 000	43 560	4 047	1	0.404 7	0.004 047	0.001 563
hectare	15 500 000	107 600	10 000	2.471	1	0.01	0.003 861
sq. kilometer	1.550 E+9	10 764 000	1 000 000	247.1	100	1	0.386 1
sq. mile	4.014 E+9	27 880 000	2 590 000	640	259	2.590	1

C. VOLUME:

Unit	Equivalent(a) (b)							
	cu. inch	liter	U.S gallon	cu. foot	cu. yard	cu. meter(c)	acre-foot	sec-foot-day
cubic inch	1	0.016 39	0.004 329	578.7 E-6	21.43 E-6	16.39 E-6	13.29 E-9	6.598 E-9
liter	61.02	1	0.264 2	0.035 31	0.001 308	0.001	810.6 E-9	408.7 E-9
U.S. gallon	231.0	3.785	1	0.133 7	0.004 951	0.003 785	3.068 E-6	1.547 E-5
cubic foot	1 728	28.32	7.481	1	0.037 04	0.028 32	22.95 E-6	11.57 E-6
cubic yard	46 660	764.6	202.0	27	1	0.764 6	619.8 E-6	312.5 E-6
cubic meter(c)	61 020	1 000	264.2	35.31	1.308	1	810.6 E-6	408.7 E-6
acre-foot	75.27 E−6	1 233 000	325 900	43 560	1 613	1 233	1	0.504 2
second-foot-day	149.3 E−6	2 447 000	646 400	86 400	3 200	2 447	1.983	1

D. DISCHARGE (FLOW RATE, VOLUME/TIME):

Unit	Equivalent(a) (b)					
	gallon/min	liter/sec	acre-foot/day	foot³/sec	million gal/day	meter³sec(c)
gallon/minute	1	0.063 09	0.004 419	0.002 228	0.001 440	63.09 E-6
liter/second	15.85	1	0.070 05	0.035 31	0.022 82	0.001
acre-foot/day	226.3	14.28	1	0.504 2	0.325 9	0.014 28
foot³/second	448.8	28.32	1.983	1	0.646 3	0.028 32
million gallons/day	694.4	43.81	3.069	1.547	1	0.043 81
meter³/second(c)	15 850	1 000	70.04	35.31	22.82	1

E. VELOCITY:

Unit	Equivalent(a) (b)				
	foot/day	kilometer/hour	foot/sec	mile/hour	meter/sec(c)
foot/day	1	12.70 E-6	11.57 E-6	7.891 E-6	3.528 E-6
kilometer/hour	78 740	1	0.911 3	0.621 4	0.277 8
foot/second	86 400	1.097	1	0.681 8	0.304 8
mile/hour	126 700	1.609	1.467	1	0.447 0
meter/second(c)	283 500	3.600	3.281	2.237	1

* Taken from System International D'Unites, Metric Measurement in Water Resources Engineering, prepared for the Universities Council on Water Resources, June 1976.

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SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

"NEAR SURFACE" FLOW SYSTEM

West of the main scarp in Las Vegas Valley, the "near surface" zone is saturated alluvium closest to the land surface. Its westward extent becomes indistinguishable from fan sediments in the vicinity of Jones Boulevard. Northeast of the scarp there is no lithologic basis for definition of a "near surface" zone. In lower Las Vegas Valley the "near surface" zone is a shallow aquifer consisting of saturated, unconsolidated sands and gravels whose thickness ranges from about 20 feet to 100 feet. This area is underlain by an aquitard consisting of fine grained sediments of unknown thickness.

The "near surface" flow system is unconfined except possibly in a few very localized areas. It is in hydraulic continuity with underlying saturated sediments. Historically it has been recharged principally by upward leakage from underlying aquifers. Because of pumping from deep aquifers since the middle 1940's, potential gradient in the "near surface" zone in the northwest subarea appears to have been reversed so ground water leaks downward into underlying aquifers. In the southwest subarea, downward leakage occurs principally in the vicinity of heavy pumping while in other parts of the subarea there is still upward leakage into the "near surface" zone. In the northeast subarea there is probably little net vertical movement of ground water at depth. In lower Las Vegas Valley, ground water moves from the "near surface" zone into underlying sediments on upper parts of the fan near Henderson and BMI. In lower parts of the area near Las Vegas Wash, the situation is reversed.

Recharge to the "near surface" zone occurs mainly as a result of lawn, golf course, and agricultural irrigation and septic tanks throughout the Valley and from industrial waste disposal practices in lower Las Vegas Valley. Of the 143,000 acre feet of water delivered in the Valley during 1973, about 40,000 acre feet, or 28 percent were recharged to the "near surface" zone. Of the total recharge in the Valley, about 27,000 acre feet were from irrigation and about 1,600 acre feet were from septic tanks. About 10,000 acre feet of recharge occurred in lower Las Vegas Valley as a consequence of municipal and industrial waste disposal practices.

SIMULATION MODELING RESULTS

Attempts to use digital modeling techniques to simulate flow in the "near surface" zone were largely unsuccessful. Lack of success is attributable to insufficiencies in kinds and quality of data available for input to the analysis. These insufficiencies made it impossible to define boundary conditions and hydrogeologic parameters with sufficient precision to be reasonably confident of unique solutions to the flow equations. Although both temporal and spacial distribution of data presented difficulties, principal problems were inability to define the surface of hydraulic potentials at the lower boundary of the "near surface" zone and lack of distributed information pertaining to hydraulic conductivities.

In the northwest subarea, hydraulic conductivities appear to be about 5.3 feet/day. Recharge from irrigation is about 8,400 acre feet per year and net horizontal flow out of the area across the scarp is about 3,200 acre feet per year. Therefore, net vertical leakage into underlying aquifers may be about 5,200 acre feet per year. In the southwest subarea, hydraulic conductivities are also about 5.3 feet/day. Annual recharge from the surface is about 8,100 acre feet, net annual horizontal outflow is about 5,200 acre feet, and net annual vertical leakage into underlying aquifers is about 2,900 acre feet. Therefore, it appears that about 8,100 acre feet may be leaking from the "near surface" zone into potable aquifers in the western part of the Valley. This constitutes about 12 percent of total ground-water pumpage from the Valley in 1973.

In the southeast subarea (Las Vegas Wash) digital flow modeling projected future hydraulic and water quality responses to various wastewater management options. If effluent disposal to unlined ponds ceased it would take six months to one year for cessation of surface disposal of industiral effluent in the upper ponds to have a measurable effect on discharges to the Wash. Similarly, it would take 5 to 7 months for a measurable response to cessation of surface disposal of effluent in the lower ponds.

The long-continued ground-water accretion to Las Vegas Wash is approximately 11 cubic feet per second (cfs) or about 8,000 acre feet per year. Less than one percent of this is derived from upward discharge of deep ground water. Most of this flow would be sustained by underflow from the Henderson and McCullough fans, and from shallow sediments west and northwest of the study area.

Upward leakage from the deeper aquifers is minor and ranges from 0.05 gallons per day per square foot (gpd/ft^2) at the east end of the area to near zero in the vicinity of the City of Las Vegas' sewage treatment plant. Estimated average upward leakage in the vicinity of the Wash is 0.05 million gallons per day (mgd) per million square feet or about 2.5 acre feet per day.

This research demonstrates the severity of data constraints on quantitative analysis of ground-water flow systems. Too often models are regarded as a panacea because the mathematics have been solved in terms of physical laws. However, there is relatively little discussion in literature with regard to the quality of data required as input for the various mathematically sophisticated methods of analysis. Too often modeling accuracy is discussed in terms of the parity of numerical and analytical solutions instead of in terms of resemblence between the analog and the flow system.

In terms of Las Vegas Valley, consider the concept of steady-state. Water levels in wells vary both seasonally and in the long term in accordance with water use in the Valley. It was shown that where the "near surface" zone is distinguishable as such, one boundary is the phreatic surface and another is the surface of hydraulic potentials at the bottom. It was also shown that solution of the flow equations is dependent on specification of the boundary conditions. For the problems addressed in this project, it was necessary to use water-level data spanning a three year period without regard to season or year just to get maximum areal coverage. During this period, annual ground-water pumpage was reduced by 20 percent and importation of Lake Mead water increased by 84 percent while total use increased by about 80 percent.

For quantitative analysis, all data should be reasonably representative of a common time frame. This could be achieved by maintaining continuous water-level records at a few selected representative locations plus measurements taken throughout the Valley during periods of maximum and minimum demand each year.

Water levels in wells, (aside from external influences such as pumping or recharge) may vary with depth, location and length of perforated intervals. They are also reported on the basis of varying methods of measurement. Frequently wells are mislocated by several hundred feet or more. Elevations of land surface are nearly always taken from topographic maps which could easily result in water-level elevations which are 10 feet in error in any given well. Therefore, at wells in which water levels are measured, the measuring point should be surveyed and the method of measurement should be standardized. Wells should be selected, in part, on the basis of similarity in depth and perforated intervals.

To obtain information about vertical hydraulic gradients, piezometer nests should be installed and maintained at selected points throughout the Valley. Obvious places are near pumping centers, in the vicinity of housing developments, and near golf courses. Piezometers should be installed so that distribution of hydraulic potentials in the vertical section can be determined during construction. As demonstrated earlier, water-level differences over a vertical interval are not necessarily representative of the intervening hydraulic gradient.

For this project, water levels on peripheries of model areas were little more than educated guesses except on common boundaries where sufficient numbers of water-level data were available. Where there are sufficient wells to observe water levels, it is probable the flow system is in a dynamic state. However, water-level records in these boundary areas were insufficient for development of functional relationships for their variation with time. Therefore, continuous water-level records should be maintained on areal boundaries. Observation wells or piezometers should be constructed and maintained in areas of sparse information. Future ground-water modelers should be fully cognizant of the work accomplished and the problems encountered during the conduct of this relatively complex and large scale hydrogeologic modeling effort.

RECOMMENDATIONS

Expanded use of wastewater in an arid zone urban environment characterized by marked vertical boundary conditions and upward flow gradients results in the widespread contamination of shallow aquifers and relatively rapid emergence of return flows in surface water courses and as a contaminated veneer at the water table.

Future liquid waste disposal on central and distal segments of alluvial fans in basins with external drainage should be preceded by site investigations to determine infiltration rates, quality of native ground water and degree of acceptable pollution loadings on surface water resources. Past disposal of liquid wastes to unlined ponds near Henderson has been unsuccessful for the most part. Although at least 230,000 acre feet of water were disposed of to date, storage calculations show retention of only three to six percent of the amount infiltrated which is conservatively estimated at 40 percent. Thus, true waste containment has been minimal, and environmentally, the disposal scheme is a failure insofar as wastes have migrated extensively into adjacent surface-water and ground-water resources. Company estimates of the cost to recover and impound the wastes now in the subsurface as well as anticipated future volumes was $107,000,000. Measurable reduction of this industrial return flow if present waste disposal ceased would take at least six months. However, it would probably take many decades before marked change in the total salt flux from ground water occurred.

Because surface-introduced fluids cannot migrate downward, or at least not very far, in the discharge portion of a ground-water flow system, they are not safely contained. Lateral migration is also necessarily short and the wastes typically reappear in the natural discharge areas on the Valley floor. Effluent disposal by surface spreading in the discharge portion of the flow system especially conflicts with other land and water uses because wastes are transported to the land surface where population centers and surface water bodies are often present. Las Vegas Valley in southern Nevada is a typical case in point.

To minimize environmental impact, waste disposal in such areas should occur in lined, impermeable basins where evaporation to dryness occurs and solid residues are safely landfilled. Alternatively, recharge areas can be used to allow dilution and other processes to reduce or eliminate waste toxicity. Careful planning is essential to determine the extent and acceptability of effects on other existing and future water uses if this alternative if followed. Toxic wastes produced in the minerals processing industry are not generally amenable to disposal in this manner and true containment becomes necessary.

INTRODUCTION

This study, funded by the U. S. Environmental Protection Agency over the period 1969 through 1975, was designed to quantitatively determine the effects of past water use on ground-water quality and the ground-water flow regime in the "near surface" zone in Las Vegas Valley and provide a basis for projecting both physical and hydrochemical changes which are likely to result from increasing water utlization in the area.

Intensive study of land and water use patterns and hydrogeologic conditions in the Valley focused on defining water quality conditions in the shallow aquifers to depths of 300 feet. Water quality in the "near surface" zone is greatly affected by urban and industrial land and water use practices, chief of which are liquid waste disposal, overdraft of deeper aquifers, irrigation return flows, infiltration of overland flow and disruption of natural soil conditions. The study also sought to establish the relationship between such land and water use patterns on basin-wide water quality management, particularly the ground-water aspects.

This report is the third and final part of a multi-year effort. It deals with the application of ground-water simulation modeling to aid in the definition of the hydrogeologic framework and the response of the shallow aquifers to applied stresses. Simulation modeling served a two-fold purpose in that a mass of hydraulic and geologic data could be simultaneously evaluated and serve as an analytical tool to evaluate the breadth of system response under the imposed boundary conditions, water budgets, and transmissivity distributions.

Reports on the two other phases of this study have been published as follows:

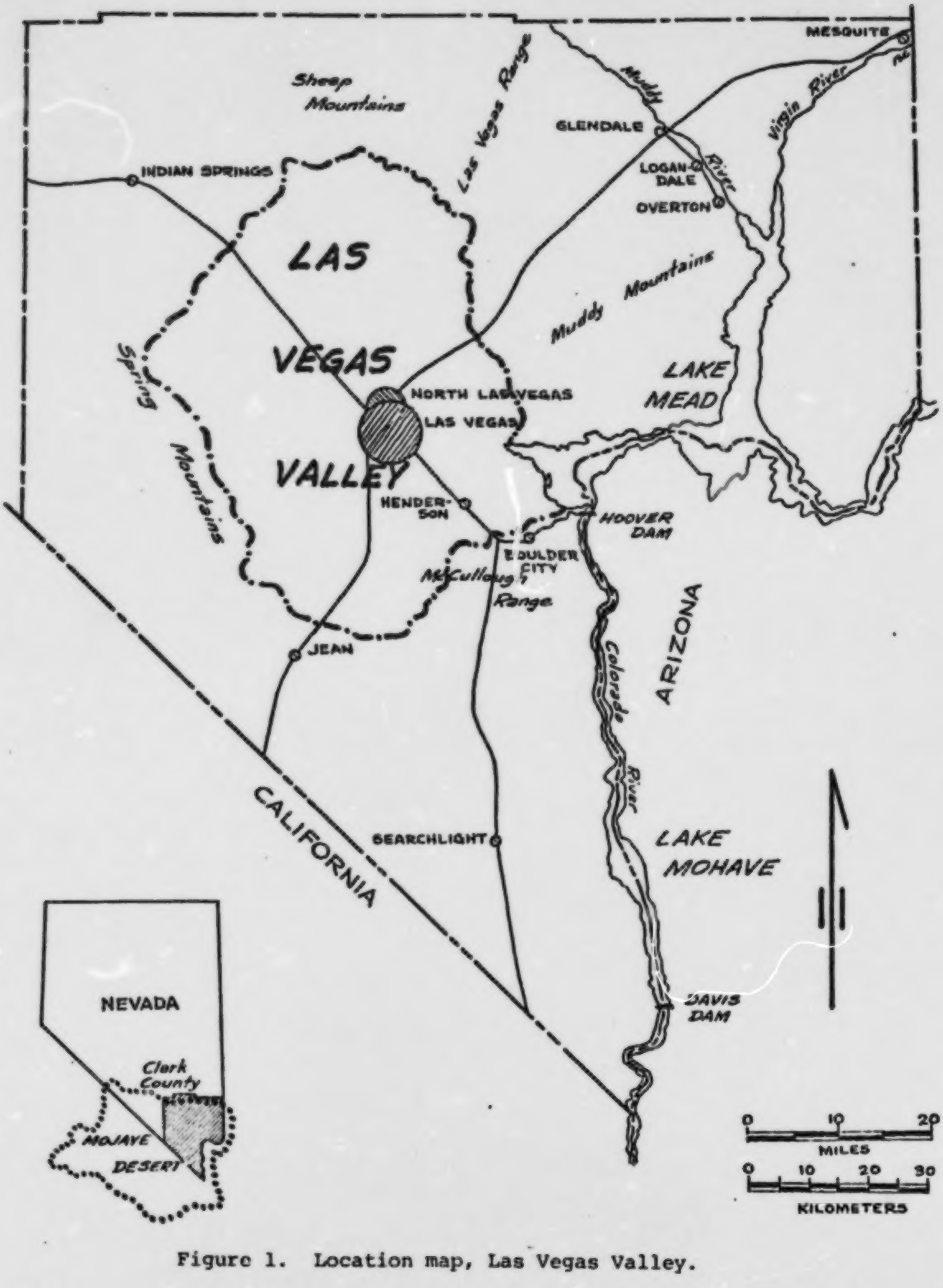
Kaufmann, Robert F., Land and Water Use Effects on Ground-Water Quality in Las Vegas Valley, December 1976, 215 pp.

Patt, Ralph O., Las Vegas Valley Water Budget: Relationship of Distribution, Consumptive Use and Recharge to Shallow Ground Water, December 1976, 63 pp.

These reports cover work that was accomplished concurrently with the work reported on herein, and the data included in them are an integral part of this report.

PHYSICAL SETTING

The Las Vegas Valley, entirely within Clark County, southern Nevada, is located in the eastcentral Mohave Desert (Figure 1). With two major exceptions, it could be described as a typical valley of the Great Basin. Those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Sheep Mountains
Las Vegas Range
Muddy River
GLENDALE
LOGANDALE
OVERTON
Virgin River
INDIAN SPRINGS
LAS VEGAS VALLEY
Muddy Mountains
Spring Mountains
NORTH LAS VEGAS
LAS VEGAS
LAKE MEAD
HENDERSON
HOOVER DAM
BOULDER CITY
McCullough Range
JEAN
ARIZONA
Colorado River
CALIFORNIA
SEARCHLIGHT
LAKE MOHAVE
N
NEVADA
Clark County
MOJAVE DESERT
DAVIS DAM
0 10 20
MILES
0 10 20 30
KILOMETERS

Figure 1. Location map, Las Vegas Valley.

exceptions are 1) the Valley is one of very few in this province with extensive urban development, and 2) it is the only one from which perennial surface flows enter the Colorado River in the Lower Colorado River Basin.

Las Vegas Valley is an intermontane arid basin which contains a thick sequence of alluvial sediments arranged vertically and laterally in a complex system of aquifers and aquitards. The most permeable sediments are in the northwestern and west-central parts of the Valley where the principal volume of ground-water extraction has occurred to date, primarily from confined aquifers at depths of 250 to 1,000 feet. Except in the west-central area, these aquifers are overlain by extensive layers of poorly permeable clay, silt, or caliche. Separating these productive zones from generally less permeable sediments to the east is a series of faults and associated scarps which impede eastward ground-water flow. The eastern part of the Valley is characterized by primarily fine-grained sediments and a shallow water table.

PRINCIPAL FEATURES OF SHALLOW GROUND-WATER OCCURRENCE AND USE

Disposition of aquifers in Las Vegas Valley is schematically shown in Figure 2. In some parts of the Valley, the predevelopment pattern of upward movement from the confined aquifers to the near surface zone has been modified in the last thirty years by heavy withdrawal of ground water from the middle zone of aquifers. This zone occurs between depths of about 450 feet and 750 feet (Maxey and Jameson, 1948). As a result, the piezometric head in the confined aquifers has been greatly lowered. It was 60 feet above land surface in parts of the Valley and it is now generally below the level of water in the near surface zone, which in the present study is defined as the upper 300 feet of valley fill and, therefore, includes the near surface and (part of) the shallow zones as defined by Maxey and Jameson (1948). Prior to extensive ground-water development, the "near surface" zone was recharged by upward movement from the underlying confined zones and by infiltration of spring flows originating in the deeper aquifers (Maxey and Jameson, 1948).

A large marshy area known as "Las Vegas" was centered about Las Vegas Creek forming an area of approximately eight square miles. A shallow water table recharged by upward movement also was present in the Duck Creek drainage, along the upper reaches of Las Vegas Wash and along the lower reaches of Flamingo and Tropicana Washes. Other discharge areas were present in the areas of Tule Springs and the Gilcrease Ranch, both in the extreme northwestern corner of the study area. In effect, discharge by evaporation and evapotranspiration equaled recharge by infiltration and upward movement and the near surface zone was in equilibrium, with no surface flow leaving the Valley. Beginning in the mid 1940's, this natural predevelopment condition underwent rapid and dramatic change. Upward movement and spring discharge was greatly reduced as a result of gradually increasing overdraft of the deeper (middle zone as defined by Maxey and Jameson, 1948) aquifers, particularly those in the western and northwestern portions of the suburban area. Whereas there has been widespread reduction in artesian head, dewatering of shallow sediments has only occurred in a north-south trending belt on the western edge of the developed area in the Valley. In the last 30 years, the "near surface" zone as defined herein has been, for the most part, the locus of increased recharge from surface sources and decreased discharge as a result of phreatophyte removal. Patt (1976) describes the changes in the near surface zone water budget from 1943 to 1973.

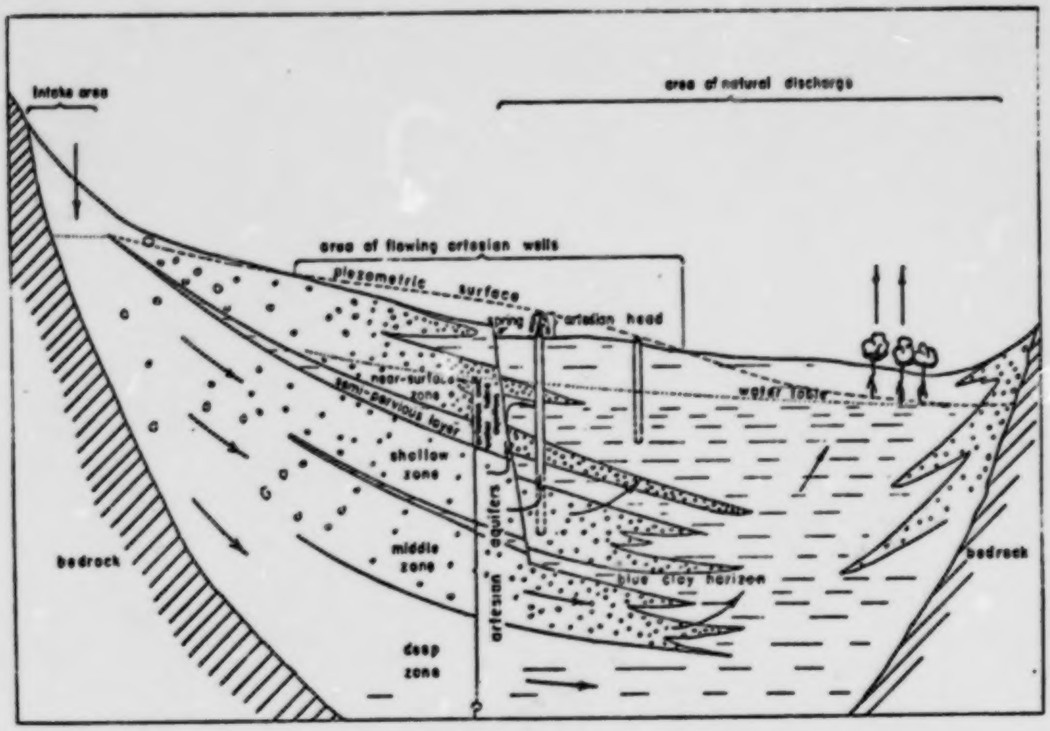

intake area
area of natural discharge
area of flowing artesian wells
piezometric surface
spring
artesian head
near-surface zone
semi-pervious layer
water table
shallow zone
middle zone
deep zone
artesian aquifers
blue clay horizon
bedrock
bedrock

Figure 2. Generalized east-west hydrogeologic cross-section showing ground-water occurrence and flow prior to extensive development (Malmberg, 1961, based on Maxey and Jameson, 1948).

Principal natural and cultural features bearing on the occurrence and quality of shallow ground water in Las Vegas Valley are shown in Figure 3. Fault scarps oriented generally north-south are geologically young but predate man's presence in the Valley. Whitney Mesa and extensions of this lineament to the north are perhaps the best surficial expressions of this faulting. These delinate the transition from fine-grained sediments to the east and coarser materials to the west. Lateral, eastward ground-water movement is impeded by a decrease in transmissivity in the fault zone areas. The largest springs in the Valley, most of which ceased to flow in the late 1940's and early 1950's, are generally located in close proximity to the scarps. This is indicative of loss of transmissivity and conduit development associated with the fault zones. Under natural conditions prior to heavy pumping, these springs were characterized by very stable flow, water quality, and temperature, indicative of a deep-seated source. The springs are now dry as a result of heavy pumping and reduced upward movement. Shallow ground water on the order of 100 feet or less, commonly appears to accumulate in the upthrown block and "weep" across an exposed scarp face. This is a mainfestation of extremely low permeability of fine-grained surficial sediments and pronounced

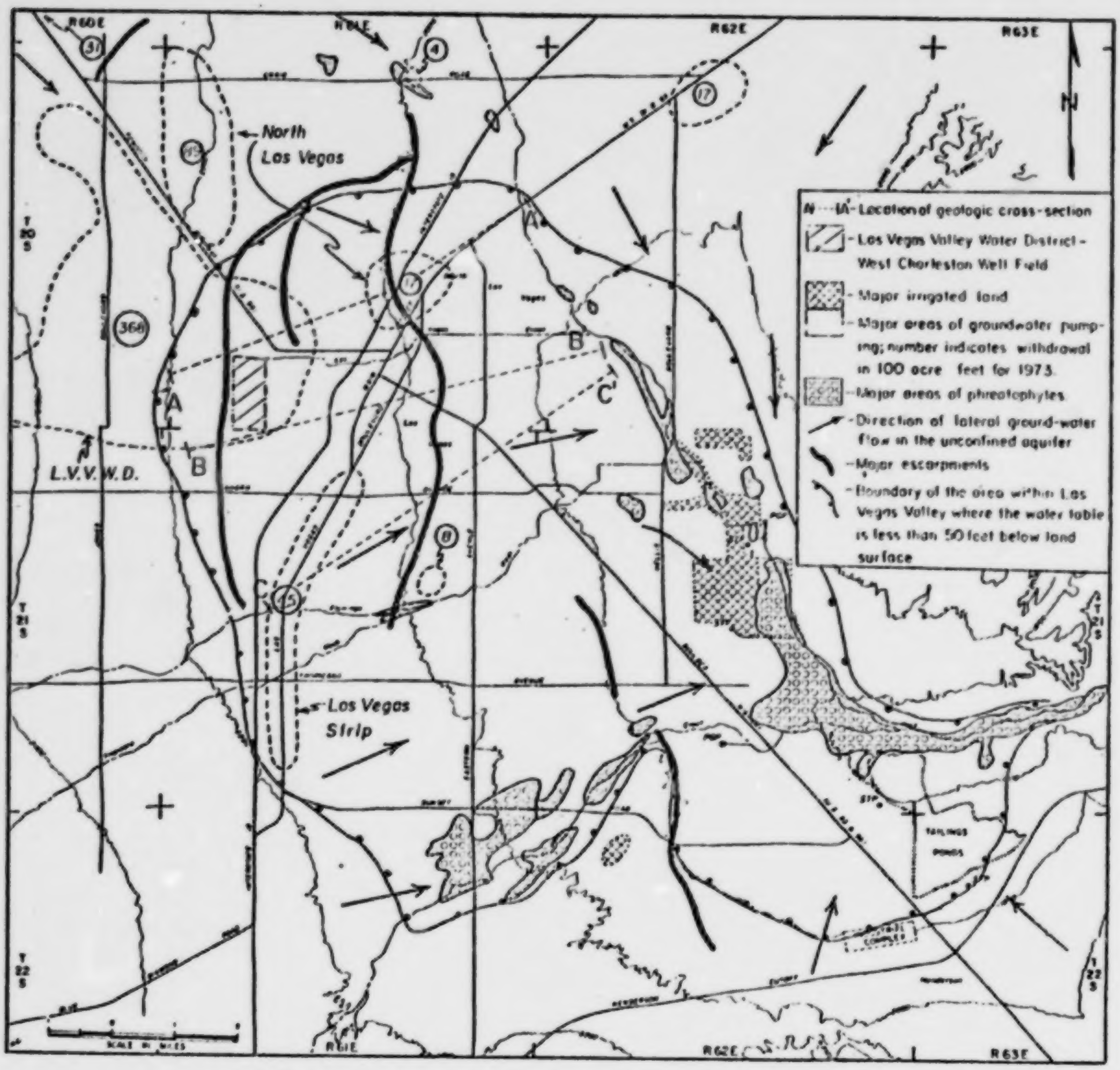

R60E
R61E
R62E
R63E
T 20 S
T 21 S
T 22 S
North Las Vegas
Los Vegas Strip
L.V.V.W.D.
A
A'
B
B'
C
C'
31
4
17
366
11
8
N
TAILINGS PONDS
A---A' - Location of geologic cross-section
Los Vegas Valley Water District - West Charleston Well Field
Major irrigated land
Major areas of groundwater pumping; number indicates withdrawal in 100 acre feet for 1973.
Major areas of phreatophytes
Direction of lateral ground-water flow in the unconfined aquifer
Major escarpments
Boundary of the area within Las Vegas Valley where the water table is less than 50 feet below land surface

Figure 3. Principal features of ground-water occurrence and development. (from Kaufmann, 1976)

boundary conditions exerted by near surface caliche layers, common in the western two-thirds of the Valley.

The areas of principal ground-water development and amount of production for public water supply are shown in Figure 3. Principal public water supply developers include the Las Vegas Valley Water District, North Las Vegas, and Nellis Air Force Base. A second major user group, the resort industry, is centered on the Las Vegas Strip and involves extensive development to support lawn irrigation and other recreational uses.

As a result of return flows from nonpoint sources and from industrial and sanitary waste discharges, an extensive high water table has developed in the eastern part of the Valley, particularly in the Las Vegas Wash area. Because the prevailing ground-water flow direction is eastward toward the lowest point in the Valley, saline, nutrient-laden ground water surfacing along Las Vegas Wash constitutes a significant baseflow component to surface flows and necessitates joint consideration of surface water and ground-water factors in basin wide water quality management.

PRINCIPAL AQUIFER ZONES

Four principal aquifers in Las Vegas Valley were identified by Maxey and Jameson (1948). In the northwestern quarter of the Valley, they recognized a near surface aquifer to depths of 200 feet. Below this, to depths of 450 feet, the shallow aquifer is present and consists of sand and gravel interbedded with silt and clay. At the base of the shallow aquifer in parts of the Valley they reported that a fairly persistent layer of blue clay overlies the highly productive middle aquifer, the principal source of ground water pumped in the Valley. A deep aquifer, recognized at depths below 700 feet in the western half of the Valley, has only been developed in recent years. Subsurface conditions vary laterally so the aforementioned aquifer relations do not generally persist east of the principal scarp.

Because of decreasing quantities of sand and gravel from west to east, aquifers in the eastern two-thirds of the Valley yield progressively less water and wells rarely exceed a depth of 500 feet. There is a loss of productivity accompanied with natural deterioration in quality toward the east and southeast. As a result, considerably less ground-water development occurs in these areas. Zones of highest transmissivity occur between depths of 200 to 900 feet in the area between Charlestion Boulevard and Tonopah Highway and west of the East 1/2, Section 32, Township 20 South, Range 61 East (20/61-32, E 1/2). The principal pumping centers are shown in Figure 3. In an area of one-half square mile, the main well field (Charleston well field) of the Las Vegas Valley Water District produced approximately 60 percent of all the ground water extracted in the Valley until 1973. Since the late 1960's, ground-water production by the Las Vegas Valley Water District and the City of North Las Vegas has rapidly shifted to the north and west and has featured deeper wells of higher yield.

Less transmissive tongues of cemented gravel separated by clay and silt aquitards are present in the remainder of the urbanized area lying west of a north-south line passing approximately through the southern reach of the Las Vegas Strip. Relatively thin gravel lenses extend east of this line.

Throughout the developed portion of the Valley, shallow aquifers in the upper few hundred feet consist of sand and gravel lenses, or thin layers of porous caliche conglomerate or caliche sandwiched between thick silt and clay sediments. Highly permeable zones, probably representing former wash channels, extend generally east-west through finer-grained sediments and are most common in township 21/61. Similar linear trending zones of high permeability are likely in those portions of Paradise Valley located in the Duck Creek subbasin.

In general, unconfined ground water is present at depths ranging from less than 10 to more than 200 feet below the land surface in the urbanized portion of the Valley. Where thick caliche units are present near the land surface, near surface ground water can be locally confined under several feet of head.

RECHARGE-DISCHARGE RELATIONS

Previous studies by Maxey and Jameson (1948) and Malmberg (1961) concluded that recharge to the Las Vegas Valley ground-water basin is a result of precipitation in surrounding mountainous catchment areas. Rainfall and snowmelt in the Spring Mountains and, to a lesser extent in the Las Vegas and Sheep ranges, probably infiltrate directly into the bedrock or flanking alluvial aprons. Minor recharge probably occurs in the McCullough Range and possibly from the Frenchman-Sunrise Mountain block east of the Valley. Studies by Winograd and Friedman (1972) and more recently by Winograd and Thordarson (1975) indicate that the recharge area may extend beyond the topographic basin but to what extent in terms of area and volume of recharge is unknown. Figure 3 illustrates the principal directions of lateral flow in the near surface zone.

Estimates of recharge and discharge prepared by Maxey and Jameson (1948) and Malmberg (1965) indicate ground-water flux of 21,000 to 35,000 acre feet per year under natural conditions. With heavy overdraft of the artesian aquifers beginning in the mid-1940's, followed by importation of water in the 1950's, the natural water balance has been severely disrupted in terms of volume, distribution, and quality because discharge formerly equaled recharge and no water (except flood flows) exited the Valley except flow from uncontrolled flowing wells in the 1920's and 1930's.

The principal sources of recharge to the near surface system include irrigation return flows, septic tank and sewage treatment plant effluents, industrial effluent ditches and disposal ponds, and upward flow from deeper, artesian aquifers. Discharge from the system occurs as direct evaporation, evapotranspiration from phreatophytes, and discharge to surface water courses. Ground-water discharge causing surface flow is significant only in the Las Vegas Wash area. In the remainder of the Valley recharge to the near surface system results in positive change in storage, downward movement to the deeper, heavily pumped aquifers, and development of small springs and seeps.

Under natural, predevelopment conditions, the only ground-water outflow from the Valley was Las Vegas Wash underflow which is estimated at about 250 acre feet per year or less. At present an additional 12,300 acre feet per year of underflow surfaces in the lower reaches of Las Vegas Wash

(Kaufmann, 1971; Westphal and Nork, 1972). In the developed portions of the Valley, major springs and artesian wells have ceased to flow as a result of heavy pumping. Extensive mesquite groves and stands of saltbush that formerly discharged 25,000 acre feet per year have been removed and replaced with suburban sprawl and extensive lawns. Exclusive of Henderson and the BMI effluents, recharge to the shallow aquifer in 1973 amounted to 38,500 acre feet per year (Patt, 1976) and represented water which was 1) going into storage, 2) leaking downward to recharge the deeper aquifers, or 3) flowing laterally toward Las Vegas Wash.

HYDROLOGY OF THE NEAR SURFACE ZONE

BACKGROUND FOR THE MODELING CONCEPT

In arid regions, such as southern Nevada, water use is constrained by both availability and quality of the resource. In such an area it is necessary to develop a management policy to insure that the resource is adequate to meet projected demands. For effective management to be a reality, interrelationships between water and related resources must be understood in quantitative terms. This requires knowledge of the behavior of individual resource systems. With respect to ground-water flow systems, the occurrence, movement and quality of water must be known and changes which may occur in the system in association with human activity must be anticipated. With the advent of digital computers, methods have been developed for making more comprehensive evaluation of flow systems' behavior.

Physical principles which govern flow of ground water are 1) conservation of mass and energy and 2) Darcy's Law. Differential equations describing ground-water flow can be derived from these principles. It is through equations that the analogies between ground-water flow and the phenomena of heat flow and flow of electricity are most commonly recognized. Presumption of steady-state conditions leads to the Laplace equation, or where there is a net source/sink, the Poisson equation. Unsteady flow is described by the diffusion equation. The problem of finding a solution to the first two equations is called a boundary-value problem and for the diffusion equation, an initial value problem. Although there are a number of methods by which problems posed by these equations may be solved, they all require quantitative definition of boundary conditions and in the case of the diffusion equation, the additional constraints called starting (initial) conditions.

For conceptual purposes, consider a flow system in part of a homogeneous confined aquifer. The flow system can be described by one of the previously mentioned differential equations. The problem is to determine the hydraulic potential (head) at every point within that part of the aquifer which is under consideration. To solve the problem the following conditions must be specified:

1. Aquifer geometry,
2. hydraulic potentials at the circumscribing physical boundaries (or flow rates across them), and
3. location and rates of any recharge or discharge which may occur within the circumscribing boundaries.

If aquifer parameters (hydraulic conductivity and storativity) are correctly known at every point in the aquifer, the problem can be solved in a reasonably straightforward manner. For small, uncomplicated systems with regular geometry, analytic solutions are often available. As size and complexity of the region of interest increases, available methods of solution decrease. For large, complex regions of interest, analog or numerical methods must be employed to solve the problem.

With the availability of a digital computer, numerical methods are generally more versatile than analogs for solution of ground-water flow problems. In the numerical methods approach, the region of interest is subdivided into many small but finite subregions. For each subregion, first and second derivatives of the governing flow equation are replaced by approximations. The approximations are ratios of changes in hydraulic potential to space increments or time increments, as appropriate. At this point, the flow system is described by a set of algebraic equations each of which approximately satisfies the continuity condition for a subregion. This set of equations can then be solved by iterative methods subject to boundary and initial conditions. Assuming boundary and initial conditions are known exactly and conditions of flow in the aquifer are commensurate with the assumptions used in derivation of the flow equations, it is possible to specify the desired level of accuracy for solution of the problem.

Problems arise with application of modeling concepts to real flow systems. First, reliability of the model is dependent on the accuracy with which boundary conditions, initial conditions, and aquifer parameters are known. A less obvious but equally important factor relates to the particular model which is applied. Whenever conditions in the aquifer are materially different from assumptions inherent in the particular flow equation which is being employed, the problem solution may be in jeopardy. Unfortunately, it is often difficult or impossible to assess either the direction or degree to which actual conditions deviate from implicit assumptions.

As posed by flow equations, the problem in the two-dimensional areal case is to describe the surface of hydraulic potentials which exists in the aquifer under a set of specified conditions. However, it is usually the aquifer parameters which are unknown. In most cases the distribution of hydraulic potentials is presumed to be known along with boundary conditions, initial conditions, and sources and sinks.

Solution to the problem proceeds by trial and error. Boundary conditions and the surface of hydraulic potentials are selected for a time when it may be assumed that approximate steady-state conditions prevailed in the aquifer. Distribution and magnitude of hydraulic conductivities are adjusted until the model reproduces the surface of potentials. Next, initial conditions, the time-variant distribution of hydraulic potentials, and source/sink changes are developed from historical data. The model is then operated until a distribution of storativities is achieved by which the time variant potentials can be reproduced. At this point the model is considered operational.

In precise terms it appears the problem is improperly posed; data upon which verification of the model rests is derived from observations in wells. In most cases wells are drilled for the purpose of obtaining ground water.

Pumped wells derive at least a part of their waters from storage in the aquifer. If there are sufficient wells to allow accurate depiction of hydraulic potentials throughout the system, there must also be localized storage changes in the aquifer. Therefore, a system may be in approximate equilibrium (no net change in storage) when considered in its entirety, but not internally in equilibrium at one or more of the subregions of which the model (and therefore the aquifer) is composed.

In summary, there is need for detailed knowledge of the behavior of ground-water flow systems. The theory has been developed for many aspects of ground-water flow and its analogs in other disciplines. Solutions to the flow equations exist and complexity of the solution increases with complexity of the system being described. All solutions require that boundary conditions (and initial conditions in the unsteady problem) and aquifer parameters be accurately known. With availability of digital computers, numerical methods are usually employed to solve the flow equations for large, complex aquifer systems. In theory the problem is specified in terms of hydraulic potential. In practice, the problem is solved for aquifer parameters by a trial and error process.

SPECIFICATION OF BOUNDARY CONDITIONS

As discussed previously, accurate specification of boundary conditions is essential for quantitative analysis of a flow system. Development of a model begins with a general description of a system and its bounds. It is around this framework that concepts of system behavior are developed and tested.

Maxey and Jameson (1948) give a general description of the "near surface" ground-water system in Las Vegas Valley. Malmberg's (1961) summary description of the near surface system includes:

1. Depths to water range from a few feet to a few tens of feet below land surface.
2. Recharge is upward leakage from underlying aquifers and downward percolation of surface water from various sources.
3. Natural discharge is solely from evapotranspiration.
4. Transmissivities are probably low and the amount of water moving laterally through the sediments is probably small.

Because the undesirable consequences of human activity with respect to the "near surface" system are most clearly manifested in the southeastern part of Las Vegas Valley, modeling efforts commenced there. Westphal and Nork (1972) reported on those efforts. The method of analysis for that area was essentially the same as that employed for the "near surface" system elsewhere in Las Vegas Valley. Therefore, discussion of modeling efforts in lower (southeastern) Las Vegas Valley will be omitted except where it is necessary for purposes of comparison.

Lithology of the "Near Surface" Zone

Several hundred drillers logs and scores of soil-boring reports were examined for lithologic and water-level data. The purposes were to determine 1) if there is a geologic basis for differentiating between the "near surface" and deeper flow systems and 2) the areal extent of the "near surface" system. Except in a few cases where well locations were verified in the field, water-level elevations and elevations of lithologic horizons were obtained through use of 7½ minute or 15 minute topographic maps in conjunction with reported well locations. As expected, drillers' descriptions of lithology were extremely variable in detail and with respect to units encountered in a given area. Cooley, Fordham, and Westphal (1973) report drillers in northern Nevada apparently differentiate between permeable sediments and those of low permeability in a consistant manner even though they do not reliably differentiate between individual low permeability sediments. It was assumed drillers in Las Vegas Valley differentiated between sediments in a manner similar to drillers in northern Nevada.

For purposes of further discussion it is helpful to divide the Valley into parts (Figure 3). A large scarp extending northwest from section 32, Township 22 South, Range 62 East (22/62-4) (Whitney Mesa vicinity) toward downtown Las Vegas then north through North Las Vegas toward Craig Country Club (20/61-3) divides Las Vegas into east and west parts. Figure 4 is a picture of the scarp in the Whitney Mesa area as viewed looking west from Gibson Road and Lake Mead Highway. Figure 5 shows the scarp in the vicinity of Las Vegas as viewed from the vicinity of the Las Vegas Wastewater Treatment Plant (21/61-10). Lower Las Vegas Valley is considered to be the area east of Whitney Mesa and southeast of Las Vegas Wastewater Treatment Plant. East Las Vegas, Pittman, and Henderson are the principal communities in lower Las Vegas Valley.

Except in lower Las Vegas Valley, the "near surface" zone consists primarily of clay and silt with interstratified deposits of sand, gravel, and caliche. Near the main north-south scarp, fine grained Muddy Creek on Pleistocene lacustrine sediments prevails at the surface and at depth. Figure is a picture of the scarp showing fine grained sediments in the vicinity of Goldfield Avenue in North Las Vegas. Water flows from the excavation indicated by the arrow in Figure 6. The horizontal line indicates the approximate upper boundary of saturation. Further west in the vicinity of Valley View Drive and the Las Vegas Expressway, areally extensive and extremely competent caliche is at the surface or near surface. As shown in Figure 7 the fine grained sediments between caliche layers are saturated and require emplacement of underdrains to allow construction in this area. Subsurface conditions are nearly identical in the vicinity of Decatur Boulevard approximately 3/4 mile to the west.

In the vicinity of the recently constructed West Charleston reservoir near Buffalo Drive, there is a thick section of unsaturated, moderately well cemented sands and gravels (Figure 8). Significant amounts of aquitard materials in upper zones are absent from driller reports for the general area west of Jones Boulevard. Stratigraphic throw decreases with each successive scarp west of the main north-south scarp indicating an east to west facies change from playa and lacustrine type sediments to granular materials characteristic of alluvial fans.

Las Vegas
urban area

Figure 4. Photograph of Whitney Mesa as viewed from Gibson Road and Lake Mead Highway near Henderson, Nevada.

Figure 5. Photograph of scarp in the vicinity of Las Vegas as viewed from the City of Las Vegas wastewater treatment plant.

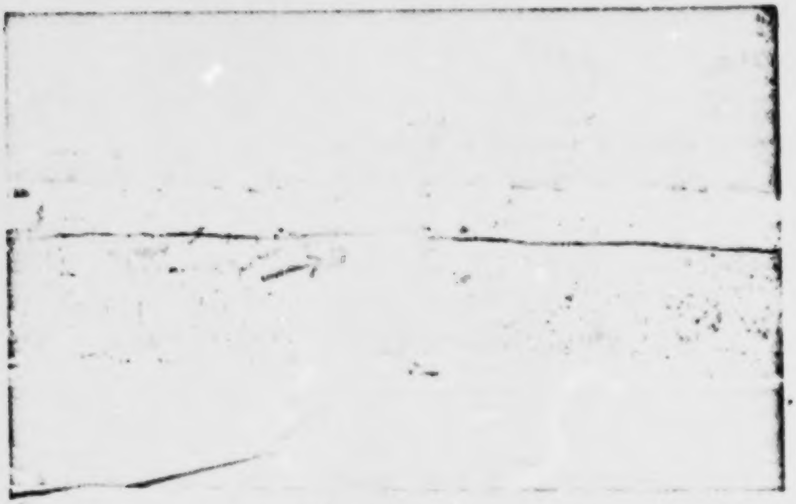


Figure 6. Photograph of scarp in the vicinity of Goldfield Avenue, North Las Vegas.

Caliche layers
Friction piles

Figure 7. Photograph of excavation for Las Vegas Expressway near Valley View Boulevard showing caliche and fine grained sediments.

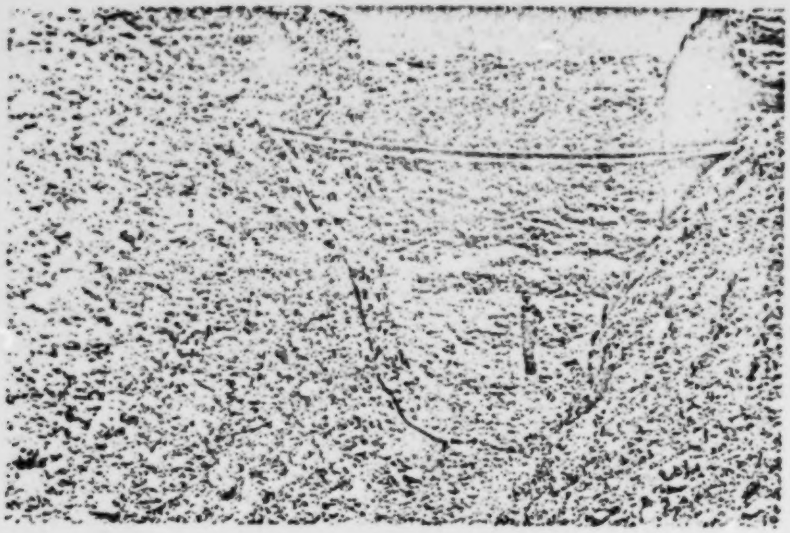
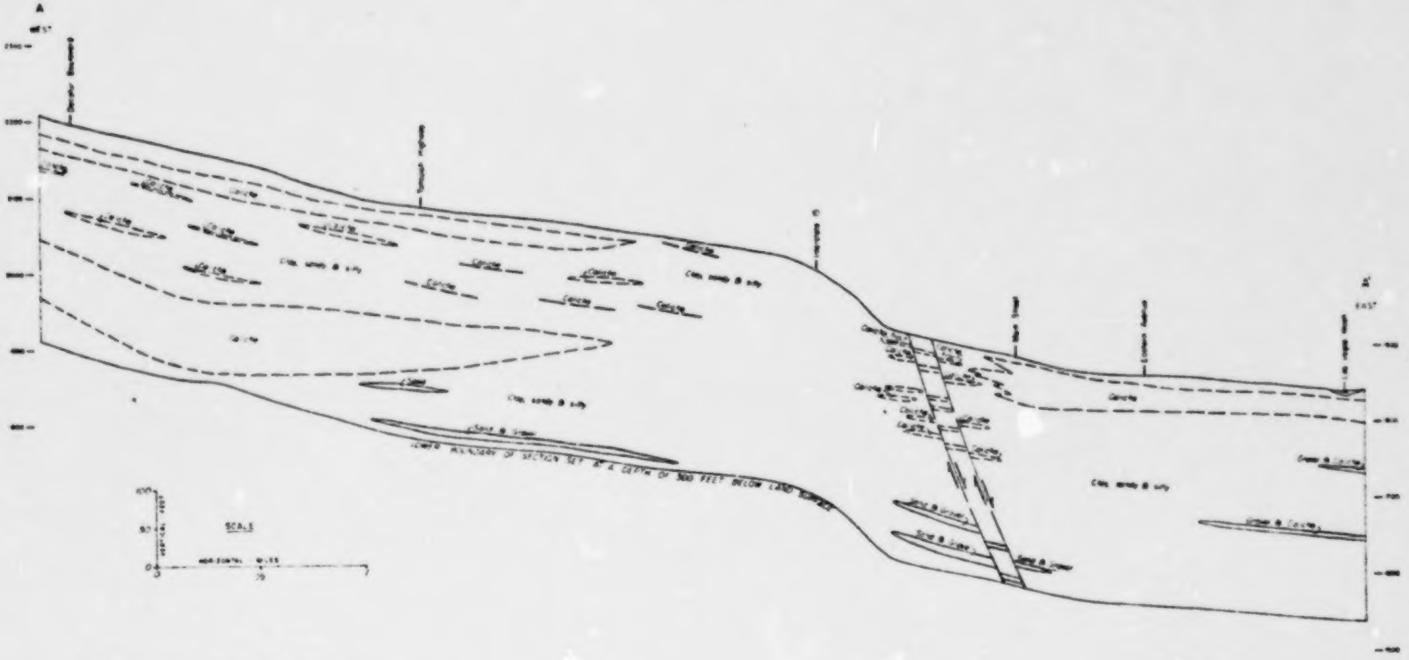


Figure 8. Photograph of excavation for West Charleston Reservoir near Buffalo Drive.

To clarify understanding of the facies changes generally described above and part of which are shown in the east-west stratigraphic cross sections A-A', B-B', and C-C' (Figures 9, 10, and 11, respectively), driller reports for wells in the western portion of the model area were analyzed to determine the amount and stratigraphic position of confining sediments in the upper 350 feet of section in the West Charleston area. The eight square mile area specifically considered included sections 31 and 32, 20/61; sections 35 and 36, 20/60; sections 1 and 2, 21/60; and sections 5 and 6, 21/61.

Each section of land was subdivided into halves, producing eight subareas with east-west and north-south dimensions of 0.5 miles and 2.0 miles, respectively. Using approximately 60 lithologic logs retrieved from the data bank for this area, the percent aquitard material was calculated using the identities shown in Table 1. Similar relationships appear in Domenico, Maxey, and Stevenson (1964). In the extreme western portion of this study area, cemented gravels constitute the major production unit.

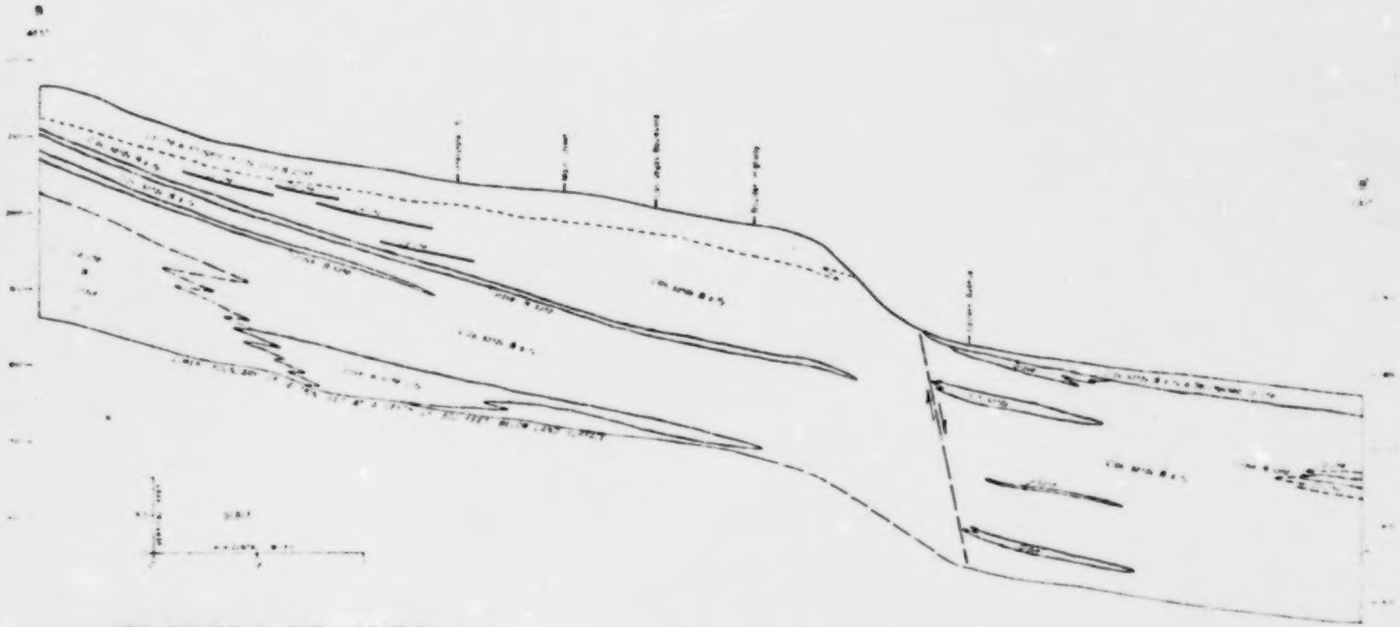
Using these designations, the percent aquitard material was calculated for each 50 foot interval of each well in the eight areas mentioned and then averaged for each 50 foot interval in a given area. The plot of average values shown in Figure 12 indicates westward pinch-out of aquitard materials. Below a depth of 150 feet there is marked thinning of aquitard materials in the area from Wilshire Street westward. The percentage remains the same or decreases slightly in shallower zones with progressive distance westward from Campbell Drive but the effect of this change, particularly in the areas of Wilshire Street and westward, is minimal because the water table is naturally depressed below the land surface due to the rapid topographic rise associated with the alluvial fan.


A
WEST
A'
EAST
Caliche
Clay, sand & silt
Sand & Gravel
LOWER BOUNDARY OF SECTION SET AT A DEPTH OF 300 FEET BELOW LAND SURFACE
SCALE
100
50
0
VERTICAL FEET
HORIZONTAL MILES
0

SEE FIGURE 3 FOR LOCATION

Reproduced from best available copy.

Figure 9. Idealized geologic cross section A-A' from the West Charleston Boulevard area to Nellis Air Force Base.



SEE FIGURE 3 FOR LOCATION

Figure 10. Idealized geologic cross section B-B' from the West Charleston Boulevard area to downtown Las Vegas.

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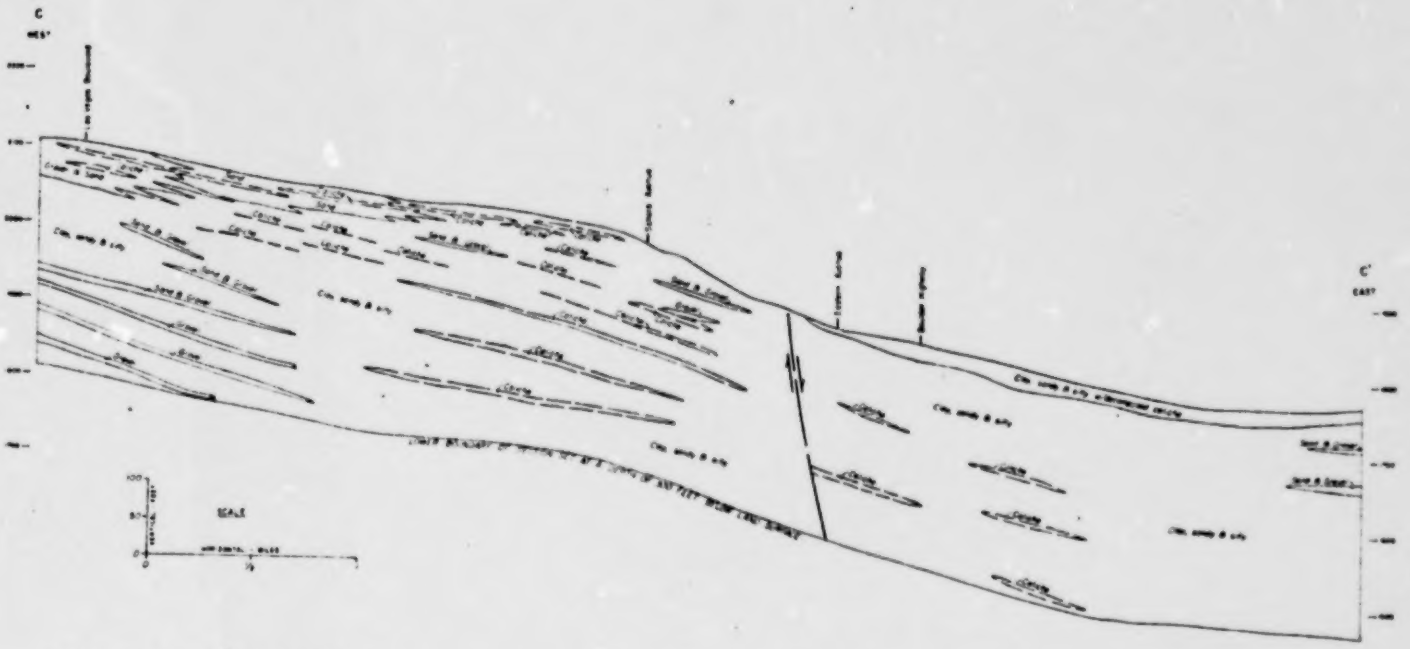
C
WEST
C'
EAST
SCALE
100
50
0
0
½

SEE FIGURE 3 FOR LOCATION

Figure 11. Idealized geologic cross section C-C' from Las Vegas Boulevard South (the "Strip") to downtown Las Vegas.

TABLE 1. PERCENT AQUITARD MATERIAL ASSOCIATED WITH TERMS APPEARING IN DRILLERS' LOGS

	% Aquitard Material
Silt and clay	100
Caliche without water reported at that interval	100
Cemented gravels without water reported at that interval	100
Sandy clay	75
Gravel with clay	75
Sandstone	75
Caliche with water	75
Cemented gravel with water	0

On the basis of the foregoing discussion and lithologic descriptions from driller reports it was possible to recognize a lower boundary (bottom) of the near surface zone in the western part of the Valley. The descriptive criteria were:

1. The top of the first thick (approximately 10') gravel stratum or sandy gravel stratum in which the driller reported ground water present or

2. The top of a sequence of alternating units of gravel or sandy gravel (approximately 5-10' thick) and clay.

As expected, definition of a lower boundary for the aquitard was not possible in the area north of Sahara Avenue and generally west of Michael Way. South of Sahara Avenue, Interstate 15 was the approximate westward limit of lithologic and water-level information. Figure 13 shows estimated elevation of the bottom of the aquitard known as the "near surface" zone in the west part of Las Vegas Valley.

In the northeast part of Las Vegas Valley, unconsolidated fine grained sediments predominate throughout the vertical section described by drillers. Nearly all the wells in this area are less than 300 feet deep and the areal distribution of wells is poor. Although most wells in the northeast part of Las Vegas Valley derive their water from lenses of sands and gravels, the entire geologic sequence of unconsolidated materials is saturated to within a few feet of land surface. Therefore, the "near surface" zone is lithologically indistinguishable from any other.

In lower Las Vegas Valley the "near surface" system constitutes a relatively shallow, thin, permeable, unconfined aquifer overlying a sequence of fine grained sediments of unknown thickness. Westphal and Nork (1972) mapped the estimated elevation of the bottom of the "near surface" zone in this area on the basis of information from driller reports.

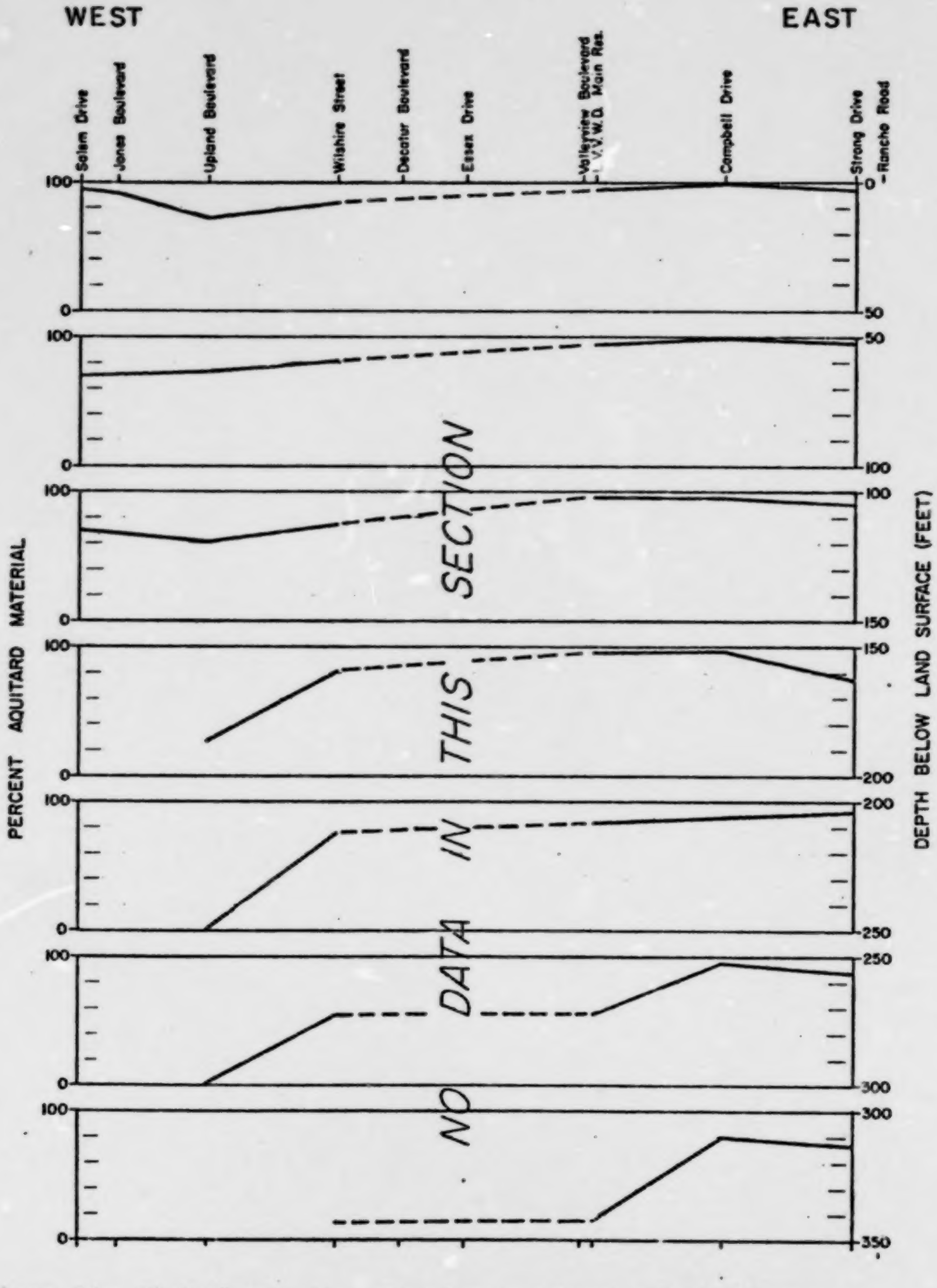

Figure 12. Plot of percent aquitard materials at selected depths, west of the scarp between Salem Drive and Rancho Road.

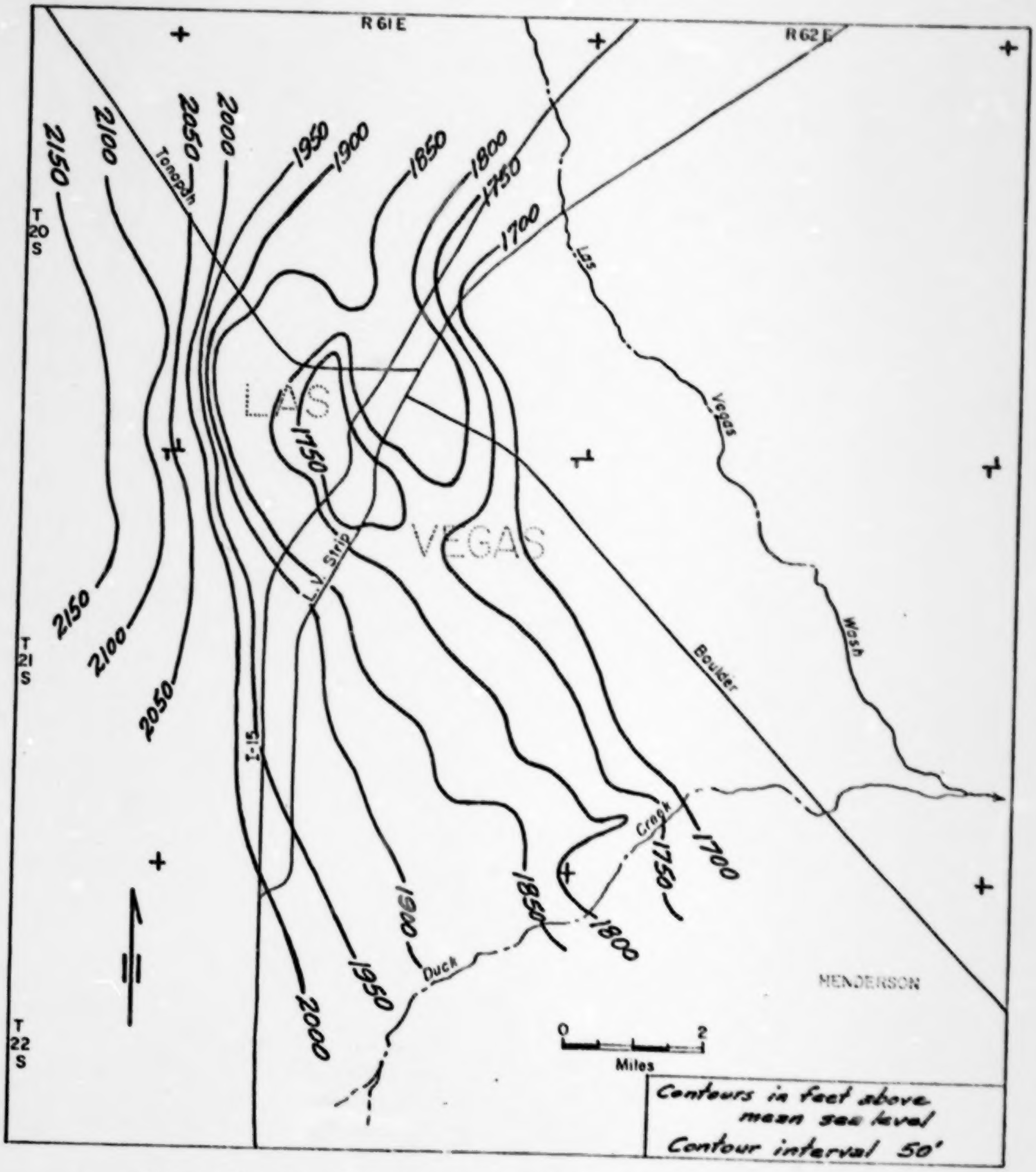
R61E
R62E
T 20 S
T 21 S
T 22 S
2150
2100
2050
2000
1950
1900
1850
1800
1750
1700
Tonopah
LAS VEGAS
L.V. Strip
I-15
Las Vegas Wash
Boulder
Duck Creek
HENDERSON
0
2
Miles
Contours in feet above mean sea level
Contour interval 50'

Figure 13. Map of estimated elevation of the bottom of the "near surface" zone.

Hydraulic Potentials in the "Near Surface" Zone

Maxey and Jameson (1948) and Malmberg (1961) report the "near surface" water is confined in some areas of Las Vegas Valley. Although informal verbal reports by a number of individuals support this assertion, documentation is absent. Caliche is commonly encountered in the Valley in surface exposures and in core borings to depths of several tens of feet. Locally, the near-surface caliche may act as an aquitard below which water is under slight artesian pressure. In other areas caliche may prevent downward percolation of ground water thereby creating locally perched conditions. However, distribution of caliche and its hydrologic effects have not been systematically investigated except on fans bordering the Valley (Cooley, Lattman, Fiero, Mindling, 1973; Cooley, Lattman, Fiero, Mindling, 1974).

Water-level data from driller's reports and Harrill (1972) were examined to determine the influence of geologic materials on hydraulic potentials in the "near surface" zone. The eight square mile area centered on West Charleston Boulevard west of Rancho Road was selected as the study area because of its proximity to the West Charleston well field, the known presence of extensive layers of caliche, and availability of comparative well data. To minimize the effect of temporal variation in water levels, wells were divided into groups according to date drilled. Water-level comparisons are shown in Table 2.

Results show hydraulic potential is above the bottom of the "near surface" zone where it is distinguishable as such. This is true even in the vicinity of the West Charleston well field where potentials in the deep artesian aquifer are 160 feet below land surface. Therefore, the concept of perched water is untenable except such as may exist in very localized situations. However, 1971-1972 data indicate a downward potential gradient which is a result of pumping from the middle and deep aquifers. The vertical gradient downward results in the migration of water from the "near surface" aquitard into underlying aquifers. Furthermore, the data suggest this vertical transfer has been occurring since the mid-1950's.

Water-level data from driller reports and soil boring records were used to construct a map of hydraulic potentials in the "near surface" zone (Figure 14). Time base for the data was 1970-1973. In the western part of the Valley water-level data were restricted to soil boring records and driller's reports for wells completed in the "near surface" zone. The exception was in the area west of Jones Boulevard (approximately) where the bottom of the "near surface" aquitard can no longer be distinguished. In that area, water levels in wells 300 feet deep or less were used. Because it was not possible to establish a "near surface" zone on the basis of lithologic data in the northeast part of the Valley, a well depth criterion of 300 feet or less was used. The work of Westphal and Nork (1972) was used for lower Las Vegas Valley.

None of the water-level data examined could be used to verify the presence of confined water within the "near surface" zone. Therefore, water-table conditions are considered to prevail throughout the "near surface" zone. Although it is clear from lithologic considerations that confined conditions must exist in a localized sense in areas of the western part of

TABLE 2. COMPARISON OF REPORTED WATER LEVELS IN WELLS OF DIFFERENT DEPTHS IN THE WEST CHARLESTON BOULEVARD AREA (from Kaufmann, 1976)

Location			Year Drilled	Well Depth (feet)	Water level elevation*	Comments
T/R	Sec	Quarter				
20/61	32	231	1951	70	2100	Very shallow wells indicating water table position only
		422	1951	140	2075	
		321	1952	160	2100	
20/60	36	443	1955	150	2156	No boundary indicated. Wells located between Decatur Blvd. and Wilshire Street
		444	1955	160	2160	
		443	1955	206	2165	
	36	41	1959	81	2150	No boundary indicated.
		432	1960	225	2149	
		444	1960	250	2135	
21/60	01	33	1959	200	2213	
		434	1960	250	2130	
		31	1961	252	2135	Boundary estimated to be between 200 to 252 feet below surface
		34	1960	300	2130	
		42	1959	300	2125	
		42	1962	300	2120	
	01	41	1954	110	2180	
		41	1955	150	2157	
		42	1955	162	2170	
		42	1954	170	2160	Boundary estimated to be 230 to 246 feet below surface
		41	1955	175	2162	
		42	1955	220	2150	
		33	1953	230	2186	
		22	1957	246	2135	
21/60	02	22	1955	240	2190	
		22	1955	243	2190	
		23	1954	260	2165	Boundary estimated to be 243 to 265 feet below surface
		23	1954	265	2165	
		22	1955	270	2140	
		22	1955	300	2155	
21/61	04	222	1971-1972	50	2057	Boundary between shallow and deeper aquifers indicated
20/61	33	323	"	170	2038	
		233	"	395	2007	
20/60	36	334	"	149	2151	Boundary between near surface and shallow aquifers indicated
	36	244	"	830	2002	
21/60	01	342	"	170	2132	
21/60	12	124	"	154	2129	Boundary between shallow and near surface aquifers indicated
		232	"	320	2031	
21/60	11	434	"	273	2044	No boundary apparent from water levels. Located between Jones Blvd. and red line of 21/61-11
		123	"	700±	2028	

* Final static water level reported by driller at time of well completion. Static level in feet above mean sea level.

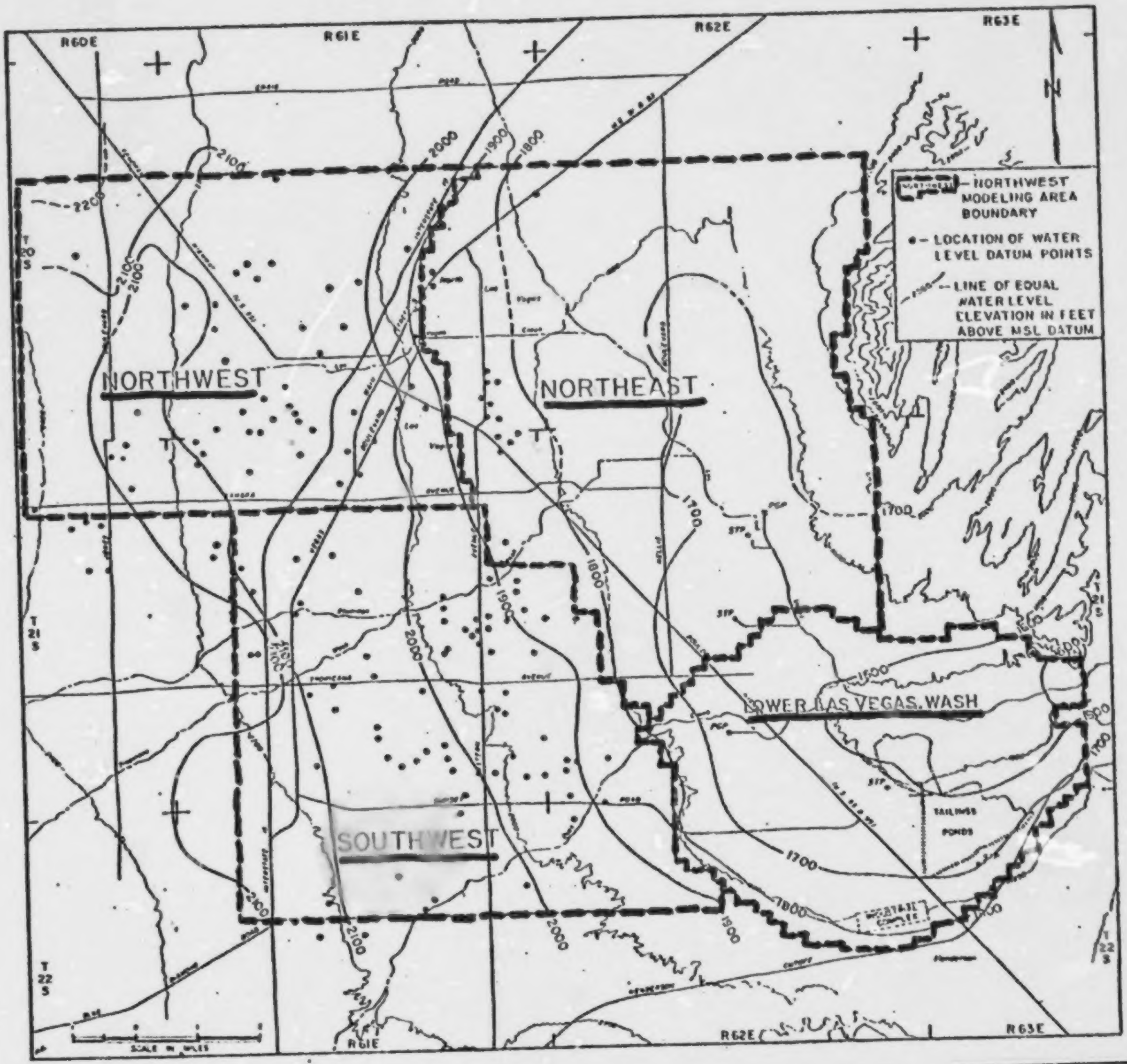
R60E
R61E
R62E
R63E
N
T 20 S
T 21 S
T 22 S
NORTHWEST MODELING AREA BOUNDARY
LOCATION OF WATER LEVEL DATUM POINTS
LINE OF EQUAL WATER LEVEL ELEVATION IN FEET ABOVE MSL DATUM
NORTHWEST
NORTHEAST
SOUTHWEST
LOWER LAS VEGAS WASH
TAILINGS PONDS
2200
2100
2000
1900
1800
1700
1500
SCALE IN MILES

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Figure 14. Water table map of the "near surface" zone, with an outline of the ground-water flow model areas. (from Kaufmann, 1976)

Las Vegas Valley, they are probably not important in terms of behavior of the "near surface" zone as a flow system.

Specification of Boundaries

Because this research was oriented toward evaluation of the effects of human activity on the "near surface" water, it was desirable to consider as much of the urbanized area as possible. In preceding discussion it was shown there are areal limits to the geologic and water-level information. A digital model is also constrained by storage available in the computer. Increasing the number of subregions (nodal areas) for a given area increases resolution capabilities of the model at the expense of computer storage requirements. If the model is to be used for evaluation of changes in the system with respect to time, specification of those areal boundaries where there is underflow poses an additional constraint. Temporal variation of those boundaries must either be known from historical data or they must be selected so they may be assumed to be invariant with respect to time.

From the beginning of this research it was clear historical records of water levels in wells completed in the "near surface" zone were few and continuous records of water distribution and associated land development in Las Vegas Valley are nonexistent. However, it appeared from preliminary examination of existing data that those records could be reconstructed for selected years in the past (except in lower Las Vegas Valley). Although non-steady state simulation was infeasible, the possibility of making comparisons on the basis of a series of steady-state models seemed realistic.

In consideration of the above factors, Las Vegas Valley was divided into four subareas, each of which was to be modeled separately. Lower Las Vegas Valley was modeled first in order to assess the effects of industrial waste-disposal practices on flows in Las Vegas Wash. Areal boundaries of the subareas are shown on Figure 14. They were selected on the basis of geology and limits of hydrologic information. The modeling effort in lower Las Vegas Valley was supported jointly by the Environmental Protection Agency and Las Vegas Valley Water District. That effort is reported in detail by Westphal and Nork (1972).

The northwest subarea is bounded on the south by Sahara Avenue, on the west by Jones Boulevard, on the north by Cheyenne Road, and on the east by the main north-south scarp, described previously. It is within this area that most domestic dwellings of Las Vegas and North Las Vegas and most groundwater pumpage from deep aquifers occur. This is the area of earliest urban development. Therefore, most historical water-level and water use data are for this area.

The southwest subarea is bounded on the east by the previously mentioned north-south scarp, on the south by a line about one mile south of and parallel to Warm Springs Road, on the west by a line about 1/5 mile west of and parallel to Interstate Highway 15, and on the north by Sahara Avenue. This area contains the famous "Strip," several golf courses, and relatively recent and continuing urban development generally known as Paradise Valley.

The northeast subarea is bounded on the west by the north-south scarp, on the north by Cheyenne Road, on the east by the alluvium-bedrock contact which occurs at an elevation of about 2000 feet above mean sea level, and on the south by a line which runs generally northeast from Whitney Mesa to Clark County wastewater treatment plant. The latter boundary is coincidental with the northern boundary of the model for lower Las Vegas Valley. Land use in the northeast subarea is agricultural, industrial, and urban, although urban development is significantly less than in other subareas. The ephemeral part of Las Vegas Wash is also located in this subarea.

Recharge to the "near surface" system from surface water occurs principally as a result of lawn and golf course irrigation. In lower Las Vegas Valley, industrial effluent percolating downward from holding ponds was also a major source of ground-water recharge during 1971-1972. Historically, the presence of springs and flowing wells in Las Vegas Valley indicate the "near surface" system received recharge from deeper artesian aquifers. As discussed earlier, there is a downward potential gradient prevalent in the northwest subarea which indicates downward percolation of ground water out of the "near surface" zone. Because recharge and discharge areas are irregularly spaced or are unknown (as is the case for subsurface transfer between flow systems), a square mesh with sides of 1000 feet was used as the subregion size for all model areas. It can be shown (Remson, Hornberger, Molz, 1971) that difference equations derived for square mesh configurations are the same for both finite difference and finite element methods for solving the equations of ground-water flow. The grid system was selected so that it coincides with the Nevada coordinate system.

In view of the critical role that accurate specification of boundary conditions plays with respect to analysis of flow system behavior, it is appropriate to review compromises which have been made in their specification thus far. Boundary conditions which have been specified for all areas are 1) water table position (phreatic surface), 2) elevation of the surface depicting the bottom of the "near surface" zone, and 3) hydraulic potentials on the periphery of each model area. The latter is different from the phreatic surface in that it is constant valued whereas the phreatic surface is allowed to fluctuate to achieve a solution to the flow equations.

The northwest subarea comprises about 32 square miles. In this area less than 60 driller's reports could be used as controls for mapping elevations of the bottom of the "near surface" zone. Further, most were located in the southern half of the subarea. As discussed earlier, it was impossible to distinguish a lithologic basis for the bottom of the "near surface" zone in the area west of Jones Boulevard. Because of the variability in both description and detail between drillers, interpretation of lithology from driller's reports is highly subjective. Adding to subjectivity of the analysis is the problem of contouring between control points, particularly when surface elevations are taken from topographic maps and well locations that may only be accurate to within 330 feet. Similar arguments can be made with respect to depiction of the water table and hydraulic potentials on the periphery of the subarea. In the case of water levels, there were only 34 control points of which six are located near the west and north boundaries.

In the southwest subarea, which comprises about 42 square miles, there are about 100 control points for bottom of the "near surface" zone and about 80 control points for water table position and hydraulic potentials on the periphery. Although both density and distribution of information are better in this subarea than in the northwest, so few control points exist in west and south parts that interpretation of boundary conditions there must be considered almost speculative.

The northeast subarea encompasses about 46 square miles for which there are about 50 water-level control points. Nearly all of these are in the western half. As discussed earlier, it was not possible to differentiate between "near surface" and deeper systems on the basis of lithology.

The purpose here is not to imbue the reader with pessimism. Actually, there is probably a surfeit of information for more traditional (albeit less quantitative and less rigorous) approaches to understanding the "near surface" system. The reader should begin to understand that few hydrologic data occur as spinoff from other activity such as drilling wells for water supply. To establish a data base for more sophisticated analysis of flow systems, a systematic data collection effort must be implemented with specific objectives in mind. Otherwise, the investigator is constrained to operate somewhere between the realm of reasonableness and that of speculation.

WATER BUDGET

According to Paher (1971), Las Vegas was probably first visited by white men about 1770. Subsequently, many early visitors (among them John C. Fremont on May 3, 1844) describe the springs and meadows in diaries. Maxey and Jameson (1948) report there were 1) a few shallow dug wells by 1905 and 2) about 75 wells drilled between 1907 and 1911 which flowed. The presence of shallow wells indicates the presence of a "near surface" zone prior to extensive human development. Because annual precipitation in Las Vegas Valley is less than four inches, it seems clear the "near surface" zone originally existed by virtue of recharge from deep aquifers.

As Las Vegas grew, its water needs were met through development of the ground-water resource. Although this had the effect of reducing upward leakage, at least a part of the water found its way into the "near surface" system through percolation of irrigation water applied in excess of crop requirements. In 1942 a pipeline was built to supply the Basic Magnesium Project and the City of Henderson with water from Lake Mead. This marked the first introduction of non-native water into Las Vegas Valley. A number of investigators (most recently Kaufmann, 1971 and Westphal and Nork, 1972) have reported on effects of this importation on the "near surface" system as it exists in lower Las Vegas Valley.

In the fall of 1971, the first stage of the Southern Nevada Water Project (SNWP) began delivering Lake Mead water to various entities throughout Las Vegas Valley. With the introduction of Lake Mead water via SNWP, ground-water pumpage in Las Vegas Valley was reduced from about 85,000 acre feet to about 70,000 acre feet per year (Nevada Division of Water Resources, April 1974).

Changes in occurrence and movement of ground water in the "near surface" zone which have resulted from changes in volume and distribution of pumpage from deep aquifers and changes in water use patterns have not been systematically documented. However, it is clear those factors which relate to occurrence and movement of water in the "near surface" zone are in a dynamic state. In order to develop flow models, it was necessary to account for components of the water budget which could be measured or estimated by direct means. To gain a qualitative idea of how changes in water-use patterns might be manifested as changes in the "near surface" zone, water budgets were constructed for selected years in the past (Patt, 1976).

Water Supply and Distribution Systems

During 1973 total water use in Las Vegas Valley was 143,000 acre feet of which 73,300 acre feet were from Lake Mead and 69,700 acre feet were ground water. Potable water is delivered by five large purveyors plus a number of small private distributors and individual domestic wells (Figure 15).

Las Vegas Valley Water District (LVVWD) is a quasi-municipal corporation and the largest distributor of water in the Valley. It was created in 1948 by the Nevada State Legislature and encompasses Las Vegas, North Las Vegas, and a number of unincorporated communities in Clark County. Although they are within LVVWD boundaries, North Las Vegas and Henderson maintain separate delivery systems. Total water delivered by LVVWD during 1973 was 81,977 acre feet of which 48,674 acre were from Lake Mead and 33,303 acre feet were ground water.

The City of North of Las Vegas owns and operates a water delivery system which serves about 41,400 persons. During 1973, North Las Vegas delivered 14,177 acre feet of which 2,341 acre feet were from Lake Mead and 11, 836 acre feet were ground water.

The delivery system belonging to Basic Management, Inc. (BMI) was built during 1942 and total delivery during 1973 was 20,980 acre feet of which 14,566 acre feet was for industrial use and 6,424 acre feet was sold to the City of Henderson.

Nellis Air Force Base is a fighter pilot training station for the United States Air Force (USAF). The USAF owns and operates the water distribution system which serves a military population of about 10,000, half of whom live off base. Ground water in the amount of 1,848 acre feet was pumped from two well fields during 1973. One well field is on the base and the other about five miles west along Craig Road. During 1973 an additional 1,276 acre feet of Lake Mead water was purchased.

Pumpage in Las Vegas Valley from metered and unmetered wells during 1973 was about 15,870 acre feet. This pumpage was from wells owned by small private water companies, golf courses, trailer parks, and farms. Pumpage from private domestic wells during 1973 was about 6,900 acre feet.

Part of the effluent from the City of Las Vegas and Clark County Sanitation District (CCSD) wastewater treatment plants is reclaimed and diverted for in-valley use. During 1973, approximately 5,700 acre feet of treated

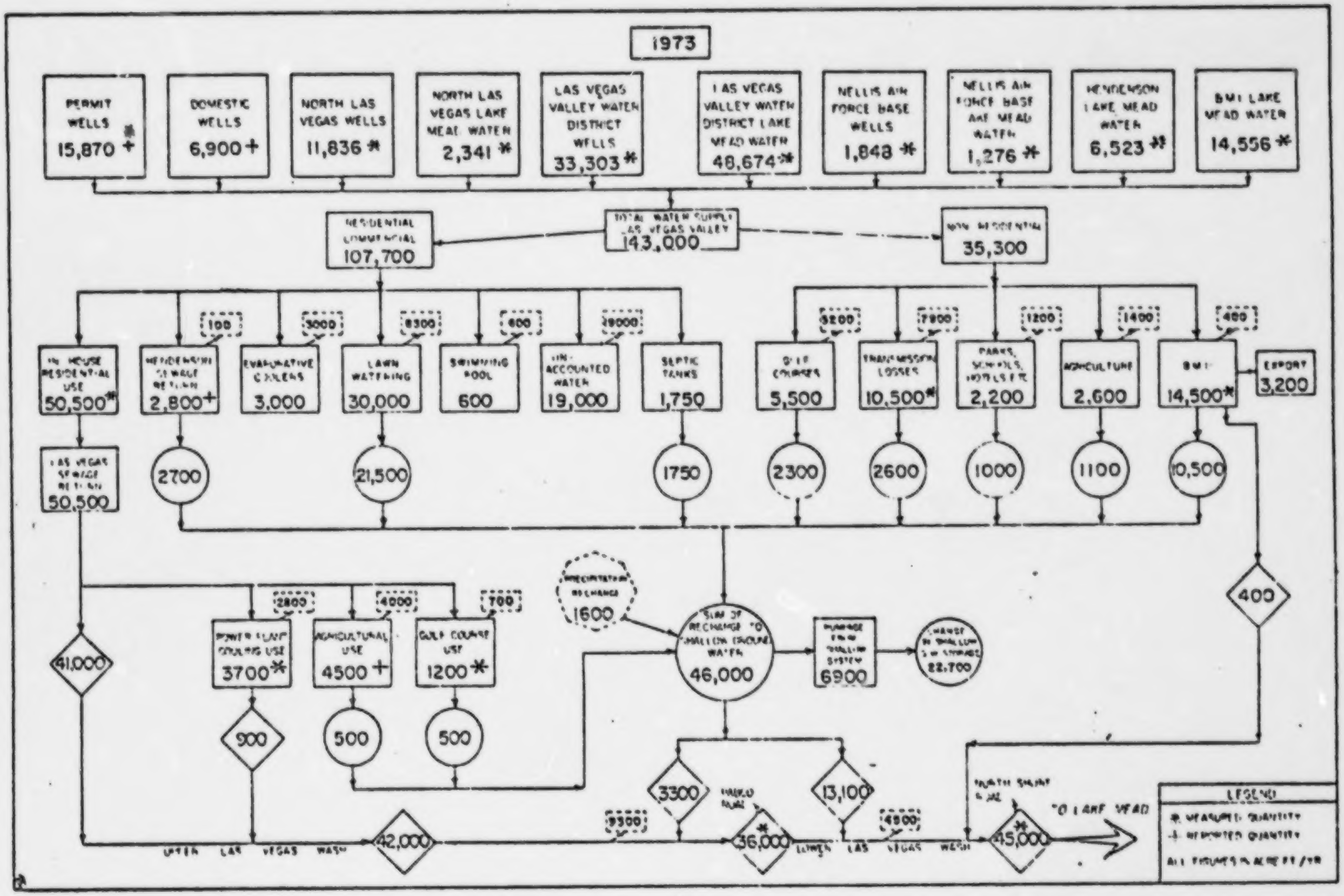
1973
PERMIT WELLS 15,870 *+
DOMESTIC WELLS 6,900 +
NORTH LAS VEGAS WELLS 11,836 *
NORTH LAS VEGAS LAKE MEAD WATER 2,341 *
LAS VEGAS VALLEY WATER DISTRICT WELLS 33,303 *
LAS VEGAS VALLEY WATER DISTRICT LAKE MEAD WATER 48,674 *
NELLIS AIR FORCE BASE WELLS 1,848 *
NELLIS AIR FORCE BASE LAKE MEAD WATER 1,276 *
HENDERSON LAKE MEAD WATER 6,523 *
BMI LAKE MEAD WATER 14,556 *
TOTAL WATER SUPPLY LAS VEGAS VALLEY 143,000
RESIDENTIAL COMMERCIAL 107,700
NON RESIDENTIAL 35,300
IN HOUSE RESIDENTIAL USE 50,500*
HENDERSON SEWAGE RETURN 2,800+
EVAPORATIVE COOLERS 3,000
LAWN WATERING 30,000
SWIMMING POOL 600
UN-ACCOUNTED WATER 19,000
SEPTIC TANKS 1,750
GOLF COURSES 5,500
TRANSMISSION LOSSES 10,500*
PARKS, SCHOOLS, HOTELS ETC 2,200
AGRICULTURE 2,600
BMI 14,500*
EXPORT 3,200
100
3000
8300
600
19000
3200
7900
1200
1400
400
LAS VEGAS SEWAGE RETURN 50,500
2700
21,500
1750
2300
2600
1000
1100
10,500
2800
4000
700
POWER PLANT COOLING USE 3700*
AGRICULTURAL USE 4500 +
GOLF COURSE USE 1200 *
41,000
900
500
500
PRECIPITATION RECHARGE 1600
SUM OF RECHARGE TO SHALLOW GROUND WATER 46,000
PUMPAGE FROM SHALLOW SYSTEM 6900
CHANGE IN SHALLOW GW STORAGE 22,700
400
3300
13,100
9300
4500
42,000
36,000
45,000
UPPER LAS VEGAS WASH
LOWER LAS VEGAS WASH
PABCO ROAD
NORTH SHORE ROAD
TO LAKE MEAD
LEGEND
* MEASURED QUANTITY
+ REPORTED QUANTITY
ALL FIGURES IN ACRE FT/YR

Figure 15. Water budget for Las Vegas Valley, 1973.
(from Patt, 1976)

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effluent from these plants were used for agriculture and irrigation of Paradise Valley and Winterwood golf courses. Treated effluent is also used for cooling purposes at Nevada Power Company power generation stations in the Valley. During 1973, 1,121 acre feet of effluent from Las Vegas and CCSD were used at Sunrise Station and 2,587 acre feet from CCSD were used at Clark Station. (All of the above figures were derived from the Nevada Division of Water Resources (DWR) Las Vegas Valley Water Inventory for 1973).

Water Use in Las Vegas Valley

To model a flow system it is necessary to know the water sources and sinks and their locations. Therefore, water supply was separated into component parts according to use. The ultimate purpose was to derive a figure for net accretion or net depletion occurring in each subregion (nodal area) of the "near surface" system within each subarea of the Valley.

Recharge to the "near surface" system occurs as a result of irrigation applications in excess of consumptive use requirements of plants. Irrigation in Las Vegas Valley is used to maintain lawns, golf courses, parks, cemetaries, and agricultural crops, primarily alfalfa. Each irrigation use was evaluated separately.

Lawn watering is the largest irrigation use in Las Vegas Valley. Estimated lawn area was based on a map developed for a transportation study done by Wilbur Clark Associates in 1965 and updated in 1973. Lawn areas in each zone were scaled from near-infrared aerial photographs flown by the National Aeronautics and Space Administration (NASA) during October 1971. Representative areas obtained in this manner were multiplied by the number of dwelling units in each respective zone to determine total lawn area. Estimated total lawn area in Las Vegas Valley is 2,431 acres.

LVVWD delivered 36,260 acre feet to 42,250 single unit dwellings from July 1972 through June 1973. The least amount of water delivered for any month during that period was 1,535 acre feet. Assuming this value represents base monthly use (no lawn watering), then 17,840 acre feet are estimated to have been applied to lawns. Average lawn size in the LVVWD service area was estimated from the NASA photographs to be 1,500 square feet. From the above figures, it is estimated that 12.26 feet of water were applied to lawns in the LVVWD service area.

For comparative purposes and to determine an approximate range of lawn water application, data from 19 single family dwellings and four condominiums in the LVVWD service area were examined. At the single family dwellings, owners were interviewed and lawn size was compared with water billing. Using the same general approach for these homes as was described in the previous paragraph, in-house use ranged from 41 gallons per day (gpd) per person to 221 gpd per person with an average of 108 gpd per person. Owners verified they did not water their lawns during the base month used to calculate in-house use. For these homes, lawn application ranged from 7.67 feet to 45.7 feet with an average of 14.7 feet. If the high value is disregarded, average application is 13.0 feet.

The condominiums studied had separate metering for their sprinkler irrigation systems. Lawn applications ranged from 5.5 feet to 13.5 feet for the period July 1972 through June 1973. Average application was 9.1 feet which is slightly less than estimates for lawns at individual residences. This may be a result of separate metering for the sprinklers or professional gardening or a combination.

Table 3 lists golf courses in Las Vegas Valley, their size, and amounts of water applied for irrigation during 1973. Golf course areas were planimetered from aerial photographs. In most cases volumes of water applied were from DWR records. Figures for Black Mountain and Nellis golf courses are estimates of the respective greens keepers. Figures for North Las Vegas and Aladdin golf courses are based on the average unit application for the other courses. Total area of golf courses in the Valley is 1,138 acres. Total volume of potable water applied to golf courses during 1973 was 5,555.4 acre feet. Total reclaimed effluent applied to golf courses for the same period was 1,206.8 acre feet. Rate of application ranged from 2.7 feet to 11.51 feet per year with an average of 5.94 feet per year. The average rate is about half that used for irrigation of lawns.

During 1973, LVVWD metered water deliveries to eight parks in the Valley. Average application for these parks was 6.3 feet. Mr. David Morby, Superintendent of the City of North Las Vegas' Department of Parks (personal communication), estimated an average application of 6.5 feet per year on parks in his jurisdiction. Area of parks, school lawns, and cemetaries in Las Vegas Valley totals 367 acres. Based on the LVVWD figures, about 2,252 acre feet of water were applied to these areas during 1973.

Five farms totaling 1,160 acres purchased 4,511 acre feet of treated effluent from the City of Las Vegas and CCSD wastewater treatment plants during 1973. Average rate of application was 3.9 feet per year. DWR records for 1973 show one farm using 2,460 acre feet of potable water on 396 acres, or 6.2 feet.

Recharge to the "near surface" zone from irrigation was calculated as the difference between water applied and consumptive use. Consumptive use was estimated by the Blaney-Criddle Method (Blaney and Criddle, 1945). Using a seasonal crop coefficient of 0.99 for grass (Tovey, Spencer, and Muckel, 1969), consumptive use of lawns, golf courses, parks, and cemetaries was estimated to be 3.47 feet per year.

Published seasonal crop coefficients for alfalfa range from 0.85 (Blaney and Criddle, 1945) to 2.61 for an unirrigated, medium soil with a water table 2.0 feet below land surface (Tovey, 1963). According to Mr. Ferren Bunker, County Extension Agent-in-Charge, Agricultural Stabilization and Conservation Service (personal communication) lawn grass and alfalfa in Las Vegas Valley have about the same seasonal consumptive use. For purposes of this study, consumptive use by alfalfa was considered to be the same as for grass.

Septic tank leach fields are a source of direct recharge to the "near surface" zone. Clark County Health Department has maintained records on septic tanks since 1954. However, locations are sometimes inexact and there

TABLE 3. GOLF COURSE IRRIGATION USING POTABLE WATER IN LAS VEGAS VALLEY, 1973

Golf Courses Using Potable Water	Area (Acres)	Volume of Irrigation Water (acre ft/yr)	Unit Rate of Application (ft/yr)
Aladdin	8	47.14*	5.89
Black Mountain	80	920.70*	11.51
Craig Road	86	335.42	3.90
Desert Inn	131	624.28	4.77
Dunes	124	829.98	6.69
International	145	927.97	6.40
Las Vegas Municipal	111	299.85	2.70
Nellis	62	484.92*	7.82
North Las Vegas Municipal	13	76.60*	5.89
Sahara Nevada	126	759.94	6.03
Tropicana	49	248.60	5.07
TOTAL	935	5555.40	
AVERAGE	5555.40 ÷ 935	=	5.94
Paradise[†]	94	710.86	7.55
Winterwood[†]	109	495.94	4.55
TOTAL	203	1206.80	
AVERAGE	1206.80 ÷ 203	=	5.94

*Estimated volume.

[†] Golf courses using treated effluent.

are no records to show that homes previously on septic tanks connect to the sewer as service expands. Although dwelling units within 400 feet of sewer lines are required to connect (Clark County Ordinance 109), this rule is not always enforced. Therefore, to get pre-1954 data and more precise locations, aerial photographs and criss-cross directories for 1943, 1950, 1958, 1965, 1970, and 1972 were used to count dwelling units more than 400 feet from sewer lines. This method shows 3,096 homes on septic tanks in 1970 versus 2,974 according to a U. S. census count for the same period.

According to Bureau of Census (1970) figures the per capita wastewater flow in Henderson, North Las Vegas, and unincorporated areas ranged from 100 gpd to 133 gpd. Cohn (1966) states there is no "standard" per capita sewage flow and such flows from single family dwellings may be in the range of 75 gpd to 125 gpd. For this study, per capita flows were estimated to be 125 gpd. The Bureau of Census (1970) gives an average of 3.1 persons per single family dwelling in Las Vegas. In 1973 there were about 3,731 single family dwellings on septic tanks in Las Vegas Valley. Therefore, recharge to the "near surface" zone from septic tanks was about 1,600 acre feet.

In terms of flow models, phreatophyte transpiration is treated similarly to pumped wells because it represents a direct transfer of water out of the flow system. Westphal and Nork (1972) estimated evapotranspiration by phreatophytes in the lower Valley to be 13 to 14 cubic feet per second (cfs). Using a value of 13.5 cfs, and an area of 2.84 square miles gives an estimate of 9,774 acre feet per year. In the northeast subarea, mesquites predominate as phreatophytes. Gatewood (1950) reports annual consumptive use of mesquite near Safford, Arizona was 3.3 acre feet. Therefore, for a phreatophyte area of about 875 acres, evapotranspiration in the northeast subarea was estimated to be 2,888 acre feet per year.

To assess relative accuracy of the water budget for Las Vegas Valley it was necessary to account for evaporative losses from power plant cooling towers, swimming pools, and evaporative (swamp) coolers. Evaporation from cooling towers, as calculated by difference between inflows and outflows, was 2,852 acre feet during 1973. Counted from the NASA near-infrared photographs, there were 4,004 swimming pools in Las Vegas in 1971. By the end of 1973, an additional 1,600 permits for pool construction (does not include above-ground pools) had been issued. Assuming 5,600 pools with an average surface area of 400 square feet and 6.6 feet evaporation, annual evaporation loss from swimming pools is about 350 acre feet.

Evaporative coolers return a considerable amount of water to the atmosphere. According to Mr. Al Barozzi (Assistant to the Manager for Special Projects, LVVWD) and Mr. Robert McCoy (Director Engineer for Artic Circle Evaporative Coolers; McGraw-Edison, Company; Phoenix, Arizona) an evaporative cooler uses about 43,200 gallons per year. The U. S. Census reports 23,283 evaporative coolers in Las Vegas Valley in 1970. Evaporative losses from these units total about 3,000 acre feet per year.

It is interesting to compare ground-water pumpage with estimated recharge to the "near surface" zone. As discussed by Westphal and Nork (1972) recharge to the "near surface" zone in the lower Valley ultimately resurfaces along Las Vegas Wash and is either consumed by plants or flows as surface water to Lake Mead. Because pumping occurs principally in west and northeast parts of the Valley, it is also in those areas where migration of water from the "near surface" zone to deeper, potable aquifers may be expected.

Table 4 shows estimated ground-water pumpage and estimated recharge to the "near surface" zone in the west and northeast parts of Las Vegas Valley. Recharge estimates are totals for the Valley reduced by the recharge attributable to BMI in the lower Valley. Clearly, pumpage from deep aquifers is much greater than recharge to the overlying "near surface" zone. Maxey and Jameson (1948) estimated recharge to Las Vegas Valley to be in the range of 25,000 acre feet to 30,000 acre feet per year. Figures in Table 4 support the contention of Maxey and Jameson (1948) that pumpage from potable aquifers probably exceeded recharge prior to 1950. The large differences between pumpage from potable aquifers and total available recharge (recharge from water applied to the "near surface" zone plus that recharged in the Spring Mountains) indicate water has been moving from the "near surface" zone into deeper aquifers at least since the late 1950's.

TABLE 4. COMPARISON OF PUMPAGE FROM DEEP AQUIFERS AND RECHARGE TO THE "NEAR SURFACE" ZONE IN WEST AND NORTHEAST PARTS OF LAS VEGAS VALLEY (volumes are in acre feet)

Year	Pumpage from deep aquifers	Recharge to "near surface" zone	Recharge minus pumpage
1950	35,217	11,327	- 23,890
1958	43,108	14,678	- 28,430
1965	72,639	16,154	- 56,485
1973	69,760	28,705	- 41,055

FLOW MODELS

Earlier sections of this report describe the modeling concept and hydrologic and geologic characteristics of the "near surface" flow system. The modeling problem was to determine how hydrologic components of this system interact in a distributive sense. After data were collected, compiled, and analyzed, it was possible to select a specific modeling approach.

Early in the project it was evident there were insufficient historical water-level and water-budget data for a non-steady model. It appeared that data for the early 1970's were adequate for construction of steady-state models providing the flow system was in approximate equilibrium. It is clear from Harrill (1972 and 1973) the "near surface" zone is not in equilibrium. However, water-level changes are not clearly defined and it appears that some areas where net water-level declines occurred during 1971-1972 may have had net increase during 1972-1973. Therefore, the choice of 1971-1973 conditions for steady-state analysis of the "near surface" flow system seemed reasonable.

As discussed earlier, boundary conditions were specified for each subarea and a mesh spacing was selected. The equation that is the basis for the models is:

$$\frac{\partial}{\partial x}\left(T_x \frac{\partial h}{\partial x}\right) + \frac{\partial}{\partial y}\left(T_y \frac{\partial h}{\partial y}\right) = \frac{W}{\delta x \delta y} + R \qquad (1)$$

where T_x = transmissivity in the "x" direction, the product of hydraulic conductivity in the x direction and saturated thickness ($K_x \cdot b$),

T_y = transmissivity in the "y" direction,

h = hydraulic potential,

W = pumpage or recharge which is independent of hydraulic potential, and

R = recharge from or discharge into, an overlying or underlying aquitard or aquifer.

The source/sink term, R, was added to equation (1) to account for vertical exchange of water between the "near surface" zone and the underlying aquifer. Obviously, this component is not measureable. Direction of groundwater flow across the lower boundary of the "near surface" zone depends on the direction of the hydraulic gradient (change in potential with respect to distance) perpendicular to the boundary. If hydraulic potential increases continuously with depth from a point inside the "near surface" zone to a point in the underlying aquifer, flow will be toward the "near surface" zone. Where the hydraulic gradient is reversed, flow will be out of the "near surface" zone. In Las Vegas Valley, vertical distribution of hydraulic potentials is unknown. Therefore, the vertical component of leakage/recharge (R) was assumed to be proportional to the difference between hydraulic potential at the phreatic surface (water table) and an assumed surface of hydraulic potentials in the underlying aquifer.

This approach to accounting for transfer of water in and out of the "near surface" zone at depth may have shortcomings, particularly in a highly anisotropic system. To demonstrate the type of error involved, a hypothetical flow system was designed having dimensions, boundaries and hydraulic conductivities in the cross section similar to those found in the "near surface" zone. The hypothetical system was modeled for conductivity ratios of 10:1, 100:1, and 1000:1, horizontal to vertical. Figures 16 and 17 show equipotential lines for conductivity ratios of 10:1 and 1000:1, respectively. Although potentials on the boundaries are identical for both cross sections, distribution of potentials within a cross section are strongly influenced by anisotropy. For the case where anisotropy is 10:1 (Figure 16), flow next to the lower boundary is either parallel or outward across it. For aniostropy of 1000:1 (Figure 17), there is upward flow into the system along the first 6,500 feet from the upgradient end. If, in the upgradient end of the hypothetical system, one piezometer were installed at the phreatic surface and another at the bottom boundary, it might be erroneously inferred from the difference in potentials there was downward leakage from the system at that point.

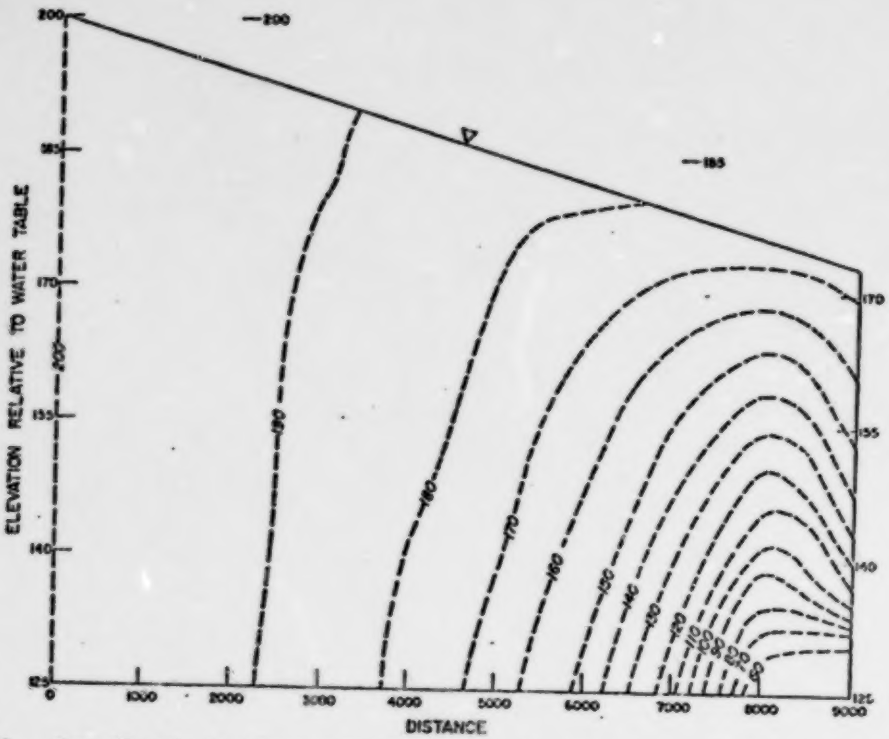


Figure 16. Hypothetical flow system with hydraulic potentials specified on all boundaries and a conductivity ratio of 10:1 horizontal to vertical.

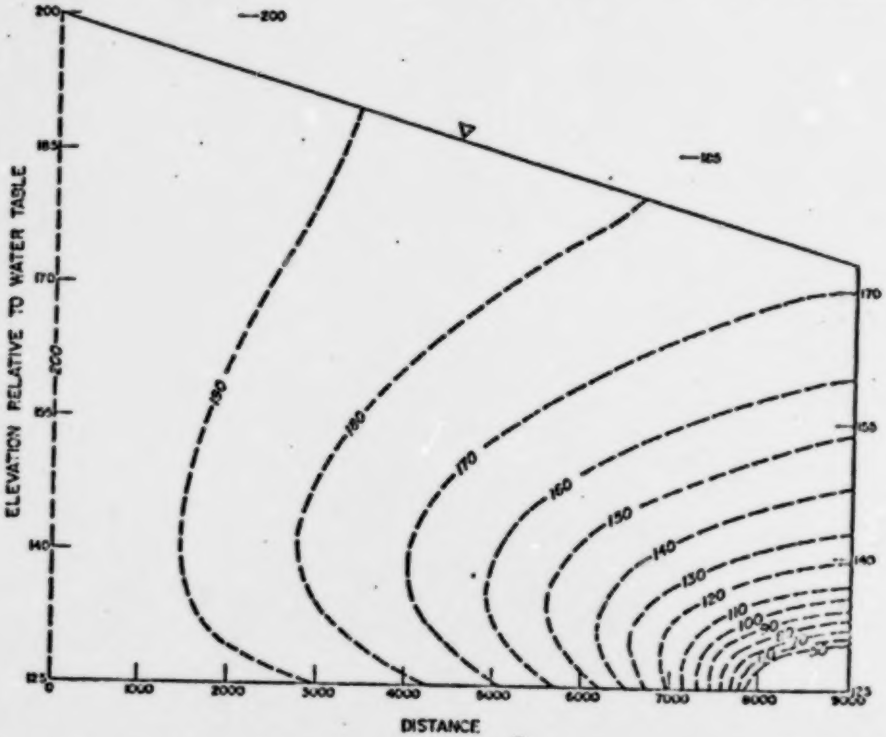


Figure 17. Hypothetical flow system with hydraulic potentials specified on all boundaries and a conductivity ratio of 1000:1 horizontal to vertical.

The same system was postulated to evaluate the concept of vertical leakage/recharge in proportion to differences between potentials at the water table and the lower boundary. Instead of specifying potentials at the lower boundary, leakage was specified for each node. Total leakage was the same as net flow across the lower boundary in the previous cases, but was redistributed in accordance with the proportionality concept being tested. The model was then operated and allowed to solve for potentials on the bottom boundary as well as those interior to the hypothetical system. Figures 18 and 19 show equipotential lines for conductivity ratios of 10:1 and 1000:1, respectively. Clearly, hydraulic potentials along the lower boundary are much lower than those originally specified and they are distributed differently. Dissimilarity between the original "realistic" cases and the "proportional leakage" cases becomes more marked with increasing anisotropy.

For the so-called "realistic" cases (Figures 18 and 19) an increase in anisotropy of two orders of magnitude results in a ten percent decrease in leakage across the lower boundary. The decrease is closely matched by a decrease in the volume of water entering the system across the phreatic surface. Net horizontal flow remains nearly unchanged. The "proportional leakage" concept constitutes a redefinition of one boundary condition for the problem. Although net transfer across the lower boundary and potentials on the remaining boundaries remain unchanged, underflow across the end boundaries and recharge across the phreatic surface are quite different than for "realistic" cases. Recharge across the phreatic surface for "realistic" cases was 43 percent and 91 percent of that for "proportional leakage" cases for anisotropies of 10:1 and 1000:1, respectively.

As discussed previously, the water budget for Las Vegas Valley appears to be accurate within 30 percent. Therefore, it appears reasonable to expect uncertainties in field data would allow concomitant adjustment of recharge across the phreatic surface and hydraulic potentials on the lower boundary such that any one of several combinations might result in a satisfactory solution to the field problem.

The usual modeling approach is to specify boundary conditions and then to adjust hydraulic conductivities by trial and error until the simulated hydraulic potentials closely match those inferred from water levels in wells. However, in Las Vegas Valley the potential distribution at the bottom of the "near surface" zone is unknown. In this case, modeling proceeded under the assumption that hydraulic conductivities could be defined from field data with sufficient precision to allow solution of the problem by adjustment of the potential surface at the bottom of the "near surface" zone.

Conductivities were estimated from pump/bail test data according to Logan's method (1964). A value was calculated for every well which had requisite data and which was also completed in the "near surface" zone. As shown in Figure 20, geographic distribution of conductivity information is poor except in the southwest subarea. Within any given subarea there was no discernible systematic variation of conductivities with location. Cooley, Fordham, and Westphal (1973) reported conductivity values for unconsolidated sediments in Truckee Meadows, Nevada were log-normally distributed. Frequency histograms of hydraulic conductivities in each of the subareas of Las Vegas Valley (Figure 20) also indicate a log-normal distribution. Therefore,

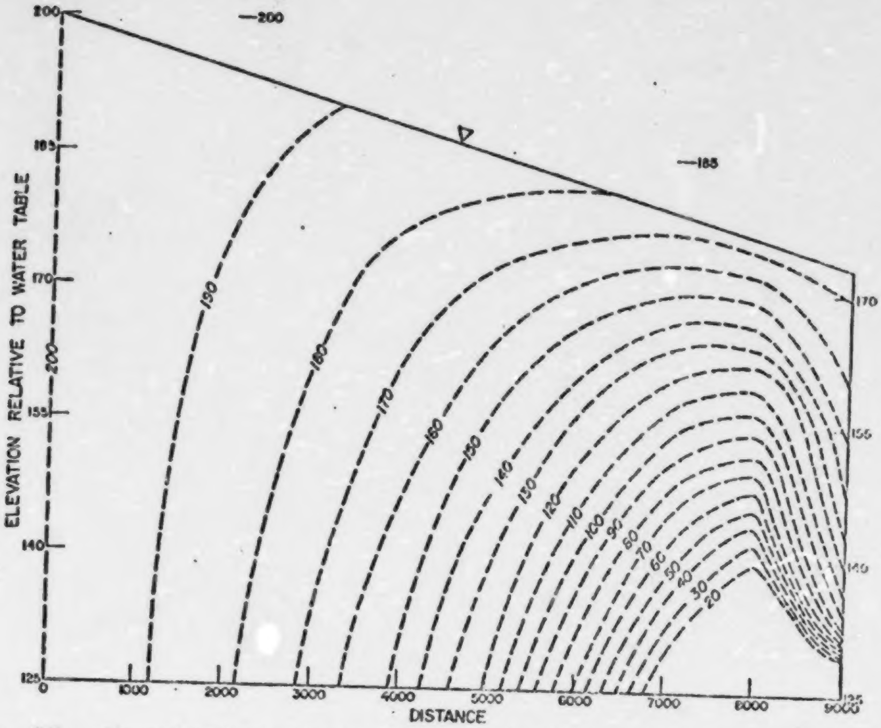


Figure 18. Hypothetical flow system with hydraulic potentials specified on ends and water table, leakage specified on the bottom boundary, and conductivity ratio of 10:1 Horizontal to vertical.

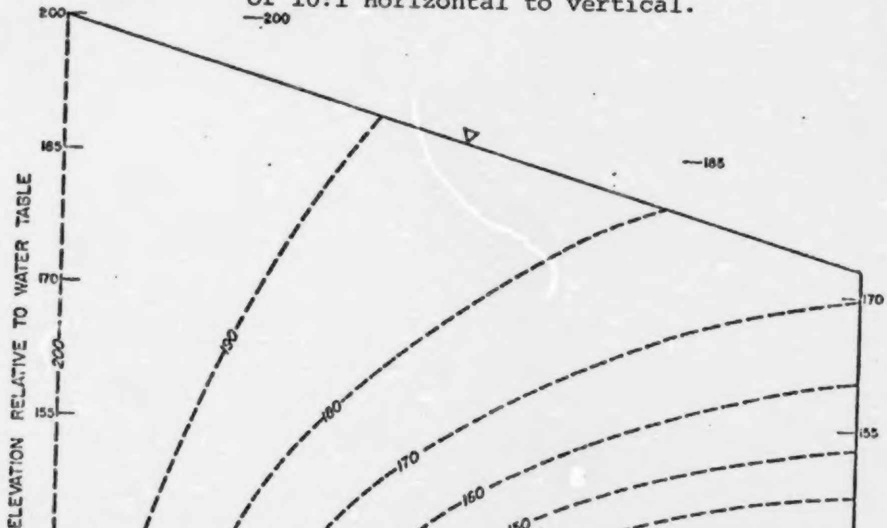


Figure 19. Hypothetical flow system with hydraulic potentials specified on ends and water table, leakage specified on the bottom boundary, and conductivity ratio of 1000:1 horizontal to vertical.

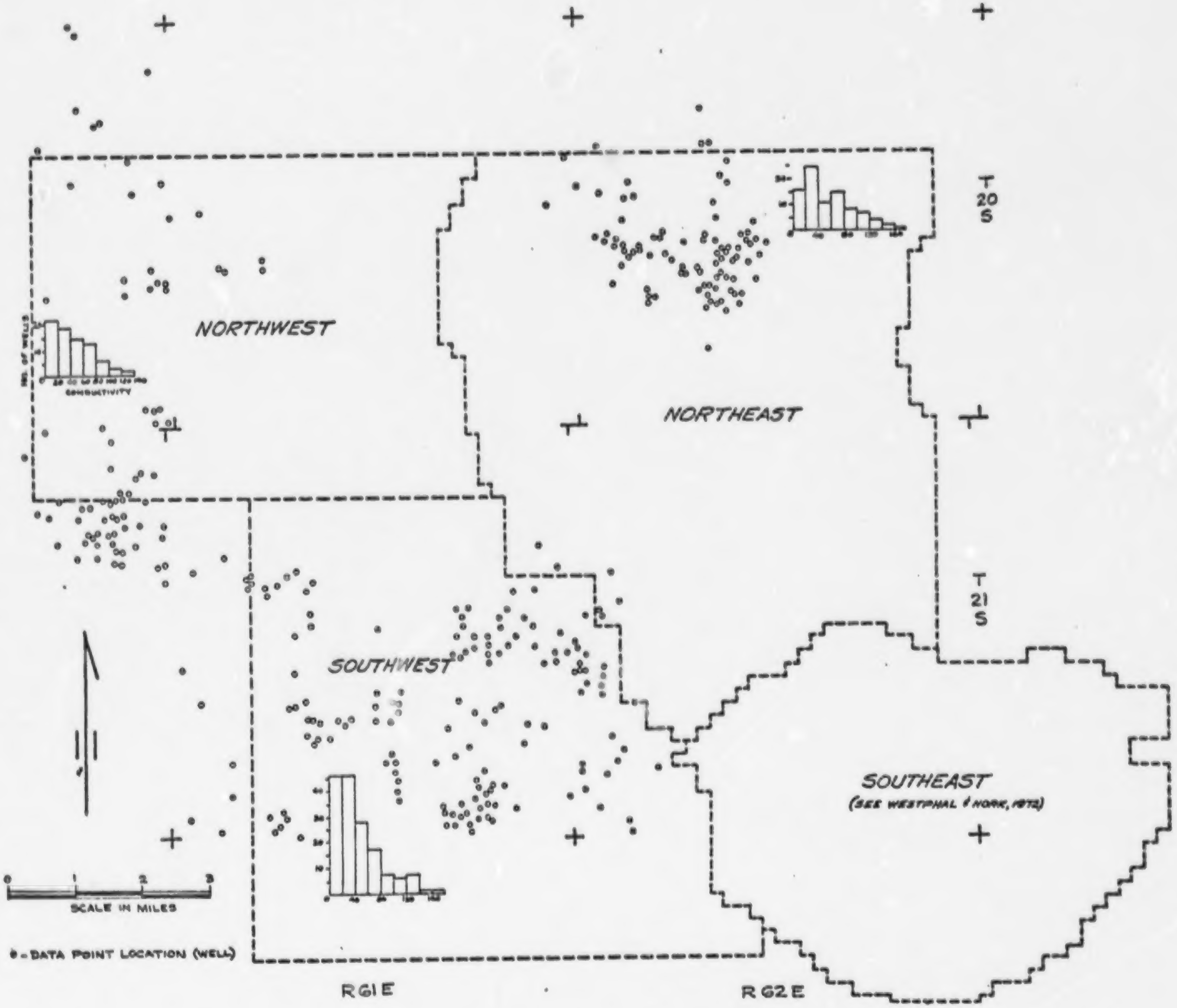

T 20 S
T 21 S
NORTHWEST
NORTHEAST
SOUTHWEST
SOUTHEAST
(SEE WESTPHAL & NORK, 1972)
NO. OF WELLS
CONDUCTIVITY
0 1 2 3
SCALE IN MILES
• - DATA POINT LOCATION (WELL)
R61E
R62E

Figure 20. Histograms of estimated hydraulic conductivity by subarea and locations of data points.

geometric mean was the value used for each subarea. Geometric mean conductivity in both western subareas was 5.3 feet/day. In the northeast subarea it was 6 feet/day.

The Strongly Implicit Prodcedure was used for models of the northwest, southwest and northeast subareas. This procedure, derived by Stone (1968), is described and programmed by Cooley (1974). Cooley's program was modified to fit the particular modeling requirements for the "near surface" zone in Las Vegas Valley. In particular, the "near surface" flow system is unconfined. Therefore, transmissivity varies according to saturated thickness. To overcome this difficulty, transmissivity was recalculated for every iteration as the product of hydraulic conductivity and the average saturated thickness between adjacent nodes.

In general, modeling procedures were the same for each subarea. First, a net recharge (or withdrawal) across the phreatic surface was calculated for each node of the model. This figure accounted for recharge from irrigation, pumpage from shallow wells, and evapotranspiration by phreatophytes. The recharge (or withdrawal) was based on estimated annual volumes. Hydraulic potentials on the periphery of each model area were held constant. Modeling progressed as a series of trial and error adjustments in the transfer of water across the bottom of the "near surface" zone with all other components of the model held constant. The concept was to find a pattern of hydraulic potentials on the bottom of the "near surface" zone which would result in a simulated phreatic surface reasonably similar to that actually observed in the subarea. Thereafter, other individual hydrologic components of the system could be adjusted individually to make simulated water levels match those observed at control points (see Appendix 1).

Northwest Subarea

The model for the northwest subarea was the first to be attempted outside the lower valley subarea. For the initial run it was assumed no leakage into underlying aquifers was present. As expected, the model simulated a potential surface which was at a higher elevation than land surface over much of the area. When hydraulic conductivity was increased by an order of magnitude, simulated water table elevations were reduced but were still higher than land surface in some areas. This indicates the occurrence of leakage from the "near surface" zone into deeper aquifers.

Because most pumpage from deep aquifers occurs in this subarea, the next few model runs were based on the assumption leakage across the lower boundary would be proportional to differences between the potential surface manifiested as water levels in deep wells and the phreatic surface. By adjusting the elevation of the surface of deep potentials relative to the phreatic surface it was possible to achieve a simulated water table configuration similar to that which actually exists. However, in detail there were substantial differences. Extreme differences between simulated and observed water levels ranged from +100 feet to -70 feet. Attempts to resolve differences through adjustments of hydraulic conductivities were unsuccessful. The pattern of differences did not coincide with either recharge patterns of topography. Therefore, it was concluded the surface of deep potentials was not sufficiently representative of the surface of potentials at the lower boundary of the "near surface" zone to be used for calculation of leakage across that boundary.

The configuration of the water table in this subarea is reminiscent of the shape of the surface of deep potentials as interpreted from water levels in deep wells. On the assumption that the shape of the potential surface on the lower boundary of the "near surface" zone might be similar to the shape of the phreatic surface, the latter configuration was used as a basis for leakage calculations in subsequent model runs. Like results of previous trials, it was possible to simulate a water table with a shape similar to the observed. Although extremes of differences between simulated and observed water levels were less than before, +65 feet and -47 feet, the pattern of differences was dissimilar. However, they still did not correspond to patterns of recharge or topography. At this point, the simulation effort for this subarea was discontinued.

There is no doubt a solution could have been achieved through a trial and error process of adjusting boundary conditions and model parameters, unfortunately, neither uniqueness nor reasonableness could be guaranteed for such a solution.

It is estimated that 8,400 acre feet per year are recharged to ground-water through irrigation of lawns and golf courses in this area. As scaled from the water-table contours shown on Figure 14, a representative hydraulic gradient across the scarp at the eastern edge of the subarea is 0.018. If average saturated thickness is about 300 feet and hydraulic conductivity is 5.3 feet/day, then annual outflow across the scarp is about 3,200 acre feet. Within the accuracy of these estimates inflow in the northwest corner of the subarea can be neglected. Therefore, net leakage from the "near surface" zone to deeper aquifers in this subarea may be about 5,200 acre feet per year.

Southwest Subarea

As in the northwest subarea, the initial run in the southwest subarea was made with the assumption there is no water transfer between the "near surface" zone and deeper aquifers. As a result, the simulated water table was several tens of feet above land surface over much of the subarea. Increasing hydraulic conductivity from 5.3 feet/day to 53 feet/day had little effect other than reducing the area over which simulated water levels were higher than land surface. This was interpreted as substantiation for net downward leakage from the "near surface" zone.

A comparison of water-level contours for deep and shallow wells as drawn by Harrill (1972) indicates hydraulic potentials in deep aquifers greater than those in the "near surface" zone over most of the subarea. There are two wells in the vicinity of Duck Creek (22/61-1 and 22/62-6), one of which is completed in the "near surface" zone, which flow at land surface. Therefore, it appears the "near surface" zone must be receiving recharge from underlying aquifers in some parts of the subarea. Because most pumpage is from north and west parts of the subarea, movement of ground water from the "near surface" zone to deep aquifers probably occurs principally in these parts simultaneously with upward leakage in other parts. Unfortunately, water-level data are insufficient to define cones of depression associated with pumping in deep wells.

For the next few runs of the model, the potential surface for deeper aquifers was approximated by a plane which sloped from southwest to northeast at the average gradient shown by Harrill (1972) on the water-level contour map for deep wells. Movement of ground water in or out of the "near surface" zone across the lower boundary was assumed to be proportional to the difference between deep potentials and phreatic surface. Relative elevation of the surface of deep potentials and size of the proportionality constant were adjusted a number of times in order to vary the distribution, direction, and amount of simulated ground-water movement across the lower boundary. Those adjustments alone were insufficient to allow satisfactory simulation of the water table.

Water-level contours drawn by Harrill (1972) were based upon measurements taken in February, a month when water use, and consequently, pumpage from wells in Las Vegas are near minimum levels. However, downward leakage from the "near surface" zone probably occurs in association with areas and during seasons of heaviest pumping from deep aquifers. Because the surface of deep potentials used previously did not reflect pumping conditions, the model was modified to adjust leakage distribution in accordance with this concept.

Annual pumpage from deep aquifers in the subarea (DWR, 1973) was totaled according to the subregion (nodal area) in which it occurred. Next, specific capacities for deep wells were calculated from data on driller reports. Specific capacities of deep wells west of Eastern Avenue were about 2.2 gpm/ft while the average for those to the east was about 1.0 gpm/ft. By dividing total pumpage at a node by the appropriate specific capacity, it was possible to estimate a drawdown equivalent which might occur if all the pumpage were removed by a single well. It was further assumed the radius of influence about each node where pumping from deep aquifers was represented was 2,500 feet. Drawdown away from the hypothetical well was distributed in proprtion to the logarithm of the ratio of radius of influence to distance from the well as inferred from the Thiem equilibrium formula (Ferris, Knowles, Brown and Stallman, 1962). The theory of images (Ferris, et al., 1962) was used to calculate total hypothetical drawdown at each node due to pumping in deep aquifers.

For the next few runs hypothetical drawdowns were subtracted from the plane representing deep potentials during conditions of minimum pumping. Like before, leakage was controlled by adjusting the relative elevation of the new surface of deep potentials and the proportionality factor. Although simulation of the water table was improved over earlier efforts there were still widespread significant disparities with observed water levels.

For the final series of model runs the surface of deep potentials was assumed to have the same shape as the observed water table. This surface was then modified as before by subtracting hypothetical cones of depression. Leakage was controlled by adjusting the proportionality factor for each run. Modeling efforts for this subarea were terminated when no apparent additional improvement was made with additional leakage adjustments.

Except in the vicinities of the Dunes and Tropicana golf courses and Paradise Valley County Park, simulated water levels were very close to those contoured on the basis of observations in shallow wells. Discrepancies between simulated and observed water levels in the vicinity of the Dunes and Tropicana could no doubt be resolved by adjusting estimated recharge from irrigation or leakage across the lower boundary, or both. Although reasons for simulation discrepancies in the vicinity of Paradise Valley County Park are less obvious, comparison of contours of the bottom of the "near surface" zone (Figure 13) with the general topography of the area indicate localized thinning of the near surface zone, which is suggestive of localized geologic controls on ground-water flow. The discrepancies could probably be resolved by reducing hydraulic conductivities locally or adjusting vertical leakage, or both. None of the possible refinements seemed justifiable in terms of time and computer costs because of the large number of equally reasonable combinations of recharge, leakage, and hydraulic conductivity which might be employed to achieve an identical result.

Approximately 8,100 acre feet per year of ground-water recharge occur in this subarea as a result of lawn and golf course irrigation. Based on estimates scaled from the water-table contour map (Figure 14) and the contour map of the bottom of the "near surface" zone, hydraulic gradient and saturated thickness were 0.0046 and 155 feet, respectively, on the west boundary and 0.021 and 140 feet, respectively, on the east boundary. Using a hydraulic conductivity of 5.3 feet/day, inflow on the west was estimated at 220 acre feet per year and outflow on the east at 5,420 acre feet per year for a net outflow of 5,200 acre feet per year. The difference between recharge and outflow, 2,900 acre feet per year, is estimated leakage from the "near surface" zone into deep aquifers. According to mass balance calculated in the model during the final simulation, net lateral outflow was 6,000 acre feet per year and net downward leakage across the lower boundary was 2,100 acre feet per year. The apparent agreement is surprisingly good and serves to re-emphasize that model accuracy is limited by accuracy of input data.

Northeast Subarea

As discussed previously, hydrogeologic conditions in the northeast subarea differ from those in other subareas since 1) no lithological basis for defining thickness of the "near surface" zone exists, 2) inferences to be drawn from water-level differences in paired deep and shallow wells with respect to vertical gradients are either inconclusive or contradictory, and 3) hydraulic conductivities appear to be higher than in the western subareas.

The bedrock contact on the east boundary consists of Permian and older carbonate rocks and Precambrian rocks (Longwell, et al., 1965). It was assumed bedrock units were relatively impermeable compared to the overlying unconsolidated alluvial sediments. Therefore, that boundary was incorporated into the model as a zero-flow boundary. Because there were only five wells in the eastern quarter of the subarea with reported water levels, water-table definition is very uncertain in this area. Its general shape was assumed to be a subdued reflection of the topography. The same rationale was also applied near the northern boundary where water-level controls are also sparse. Total net recharge distributed appropriately over the subarea was about 7,430 acre feet.

For initial model runs, bottom of the "near surface" zone was assumed to be a horizontal datum 300 feet below the lowest point on the water table.

For a given hydraulic conductivity, this had the effect of decreasing transmissivities from margins of the subarea toward the center. Initial runs demonstrated the inadequacy of this concept.

Bottom of the "near surface" zone in all subsequent runs was defined as that surface 300 feet below the observed water table. Under this concept transmissivities would be nearly uniform over any area with a given conductivity. The water table simulated on the basis of a hydraulic conductivity of 6 feet/day was not a material improvement over initial runs.

Because water-level data do not support the concept of areawide vertical movement of ground water at depth, vertical leakage in this subarea was assumed to be zero. The modeling approach was to adjust hydraulic conductivities. Conductivity data are primarily from wells located in the vicinity of the northern part of Las Vegas Wash which constitutes present day surface drainage from the area. It seems reasonable to assume sediments in the vicinity of the Wash might be more permeable than those elsewhere in the area.

Best simulation results were obtained by assuming a hydraulic conductivity of 0.5 feet/day for those sediments located west and east of the approximate break in slope between the valley bottom and east and west boundaries, respectively, and a conductivity of 6.0 feet/day in the center part of the subarea. Under this scheme, simulated water levels in the west were approximately the same as observed. However, elsewhere the only similarity was the general pattern of ground-water flow. The choice of conductivity contrast which produced the result was fortuitous and unsupported by data. Subsequent attempts to improve simulation by varying hydraulic conductivities were unsuccessful.

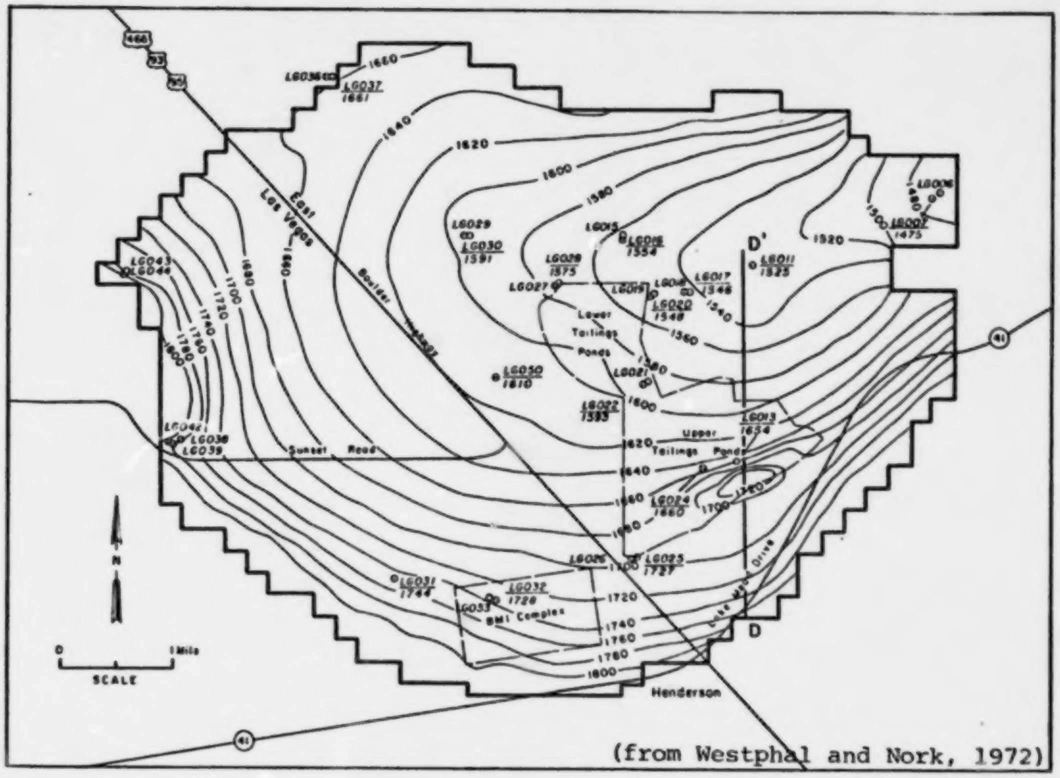
Results indicate boundaries on the east and north peripheries are incorrectly specified. The rate at which thickness of unconsolidated sediments increase away from the bedrock contact on the east is unknown. Therefore, estimated transmissivities in that area could be substantially in error. Also, bedrock outcrops to the east are highly faulted (Longwell, et al., 1965). This could result in a fracture permeability which would make the assumption of a zero-flow boundary untenable. Finally, results indicate hydraulic conductivities in the west part of the subarea may be an order of magnitude lower than those in the central part. Further attempts at simulation were abandoned because of data insufficiencies.

Southeast Subarea (Las Vegas Wash)

Hydrogeologic conditions and model development for the southeast subarea are discussed in detail in Westphal and Nork (1972). Of particular interest in that investigation was the determination of future conditions to be expected when industrial waste would no longer be discharged to the shallow groundwater systems.

December 1971 was the earliest point in time when there were sufficient data to construct the model. Unfortunately, during 1971, distribution and quantities of the principal stress on the system, BMI effluent, changed markedly. Use of lower evaporation ponds for effluent disposal was abandoned except for use involving effluent from the Henderson Sanitary Treatment Plant and the tile drain field. At the same time, production cutbacks at one plant resulted in decreased discharges of effluent which may have resulted in total decrease of diversion to the upper ponds. As is evidenced by water chemistry, the system is almost certainly not in an equilibrium condition.

Lack of documentation of system responses during the time of changing stress precluded a quantitative assessment of the state of the system relative to approximate equilibrium in December 1971. For this reason, no attempt was made to match water level control points more closely than is shown in Figure 21. Lack of historical water-level and flow data precluded verification of the nonsteady model. As a result, output from the model is probably correct in general terms but may be substantially in error in details.


466
93
95
LG036
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LG029
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1525
1520
LG006
1480
1500
LG007
1475
East
Las Vegas
Boulder
Highway
LG043
LG044
1680
1700
1720
1740
1760
1780
1800
1660
Lower
Tailings
Ponds
LG050
1810
LG021
LG022
1595
1600
LG013
1654
1620
Upper
Tailings
Ponds
1640
1660
LG024
1660
1700
1720
1680
LG042
LG038
LG039
Sunset Road
N
0
1 Mile
SCALE
LG031
1744
LG032
1728
LG033
BMI Complex
LG026
1700
LG025
1727
1720
1740
1760
1780
1800
Lake Mead Drive
D
Henderson
41
41

(from Westphal and Nork, 1972)

Figure 21. Steady-state simulation of water-level elevations in the shallow flow system, Southeast area.

Figure 21 shows approximate steady-state water levels and control points. The only serious discrepancy is at location LG026 at the west edge of the upper ponds. A localized adjustment to the model was the only way to make water levels match at this piezometer. It is probable that water levels in that piezometer reflect a localized condition,' therefore, no adjustment was attempted. The paired piezometer, LG025, is 24 feet deep (compared to 100 feet for LG026) and is occasionally dry.

Figure 21 shows ground-water mounds in the areas of both upper and lower ponds. Hydraulic gradients are north from the upper ponds toward Las Vegas

Wash indicating infiltration from the ponds and flow toward to Wash. In a similar manner the gradients indicate infiltration and flow from lower ponds toward the Wash. The upper mound is approximately 850 acres in areal extent. Model output indicates approximately seven mgd percolate into low-yield sediments beneath the mound. There is approximately two mgd underflow from across that part of the boundary upgradient from the mound. The distribution of hydraulic potentials beneath the mound prevents underflow in the shallow materials. The two mgd underflow must percolate into the low-yield sediments, thus leaving five mgd percolation to be satisfied by effluent. Because approximately 7.3 mgd effluent infiltrates from the upper ponds into shallow materials, effluent losses from the shallow materials to low-yield sediments are about 68 percent of the total which originally infiltrated from the ponds.

It is interesting to compare values for ground-water inflow crudely estimated by Kaufmann (1971) with those calculated in detail by Westphal and Nork (1972). The estimate in 1971 took into account the total monthly surface water flows into the Wash as well as the Wash flow at Pabco Road and North Shore Road. These are summarized in Figure 22 and in Table 5. The obvious hydrograph separations reveal ground water enters the Wash in the reaches above and below Pabco Road.

Quantities of ground-water inflow were calculated only for the months when sewage discharge records are most reliable, i.e., when irrigation demand and evapotranspiration losses are minimal. Total flow differences are corrected for other known surface water inputs, yielding net flow differences attributable to ground water. Net average daily return flow not accounted for in the upper reach of the Wash is 3.37 mg, much of which exits the tailing ponds with lesser amounts from commercial irrigation with sewage, and "other" general return flow from sources such as lawn watering or golf course irrigation.

Accretion in the reach below Pabco Road is approximately 5.67 mgd for a total accretion of 9.04 mgd. This compares well with the value 10.68 mgd derived from the more detailed budget analysis of Westphal and Nork (1972). Of the remaining 2.3 mgd which flows laterally toward the Wash, an additional 0.3 mgd infiltrates into the low-yield sediments. Total effluent from the upper ponds which reaches the Wash through shallow materials appears to be about two mdg. While those percolation rates are not excessive under postulated vertical gradients, they probably represent an upper limit for vertical leakage in low-permeability materials such as the low-yeild sediments.

Figures 23 through 26 show simulated water levels and water-level changes for intervals up to two years after an hypothesized cessation of effluent disposal in both upper and lower ponds. Approximate elapsed time since disposal was halted is indicated on each figure for each value of storativity.

Because of the high rate of vertical leakage, water levels in the vicinity of the upper ponds respond almost immediately to a cessation of inflow to the ponds. Within 70 to 120 days, shallow materials downgradient from the ponds became desaturated. This indicates water is leaking into the low-yield sediments at a greater rate than can be supplied from storage and underflow from adjacent shallow materials. Water levels in the vicinity of the lower

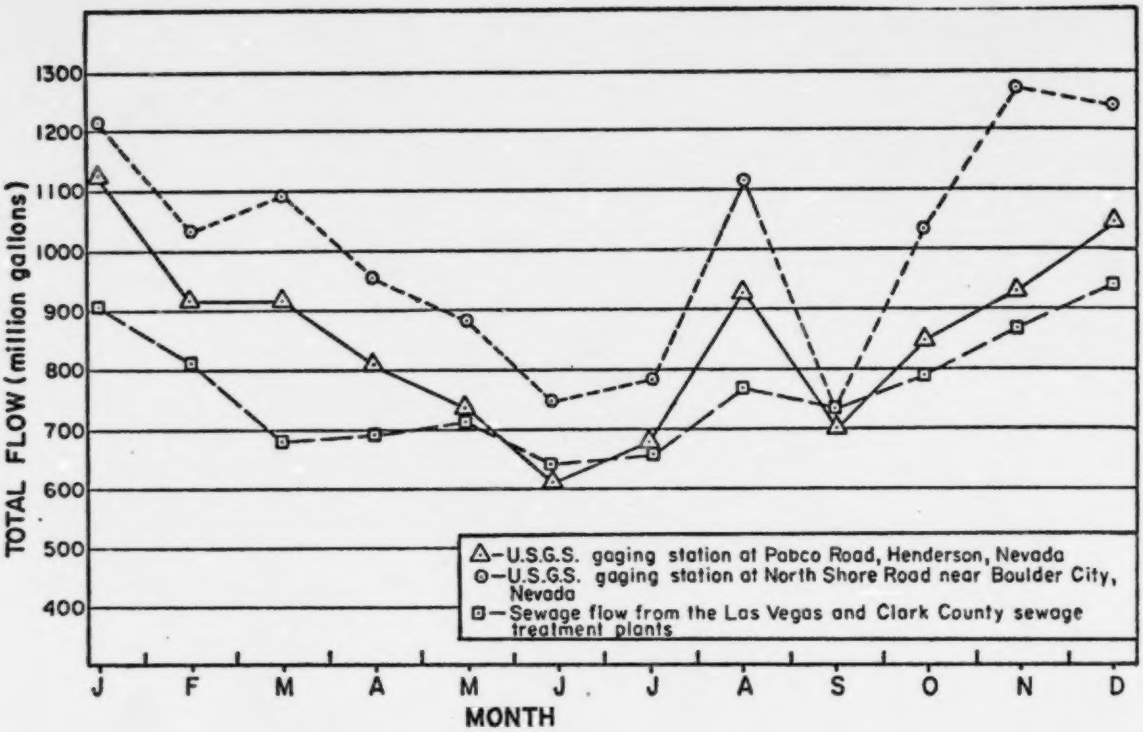


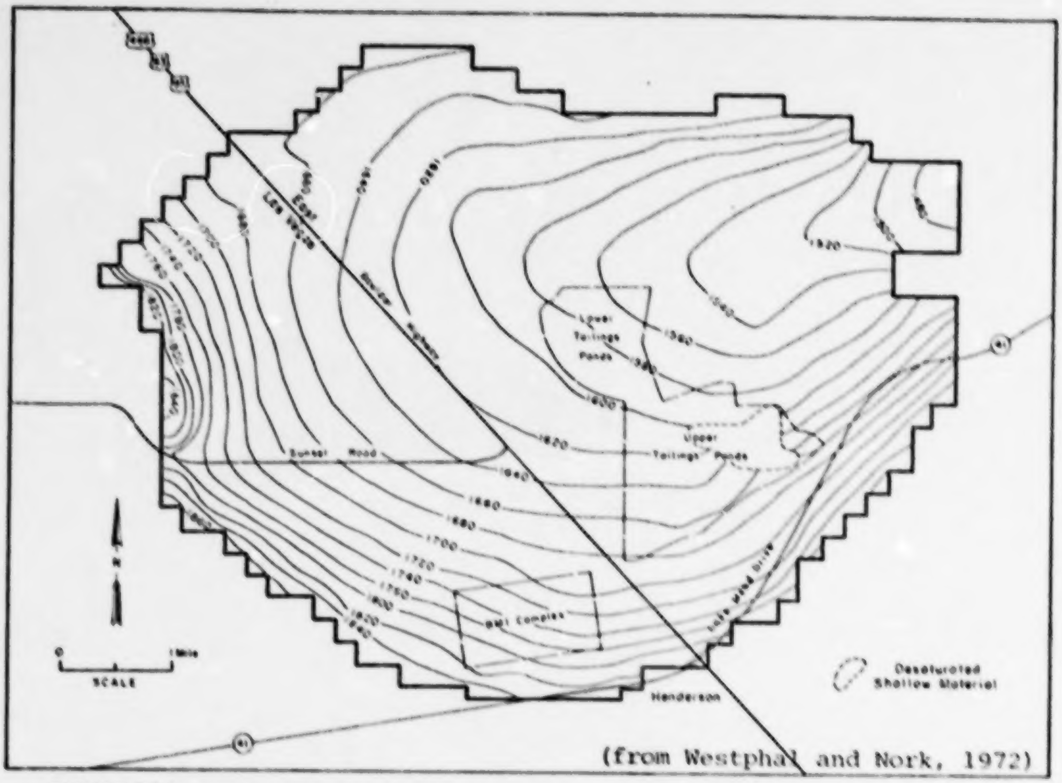
Figure 22. Hydrograph showing Las Vegas Wash discharge in 1970.

TABLE 5. FLOW IN LAS VEGAS WASH, 1969-1970 (in mgd)

	1969						1970					
	Jan.	Feb.	Mar.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Oct.	Nov.	Dec.
(1) Sewage	1010	695	610	745	815	825	908	810	680	795	870	940
(2) Pabco Road	1085	860	740	890	930	1025	1120	915	915	850	930	1045
(3) N. Shore Rd.	-	-	-	1100	1060	1145	1210	1033	1090	1033	1265	1240
Total inflow												
a) above Pabco Rd.												
(=(2)-(1))	75	165	130	145	115	200	212	105	235	55	50	105
b) below Pabco Rd.												
(=(3)-(2))	-	-	-	210	130	120	90	118	175	183	335	195

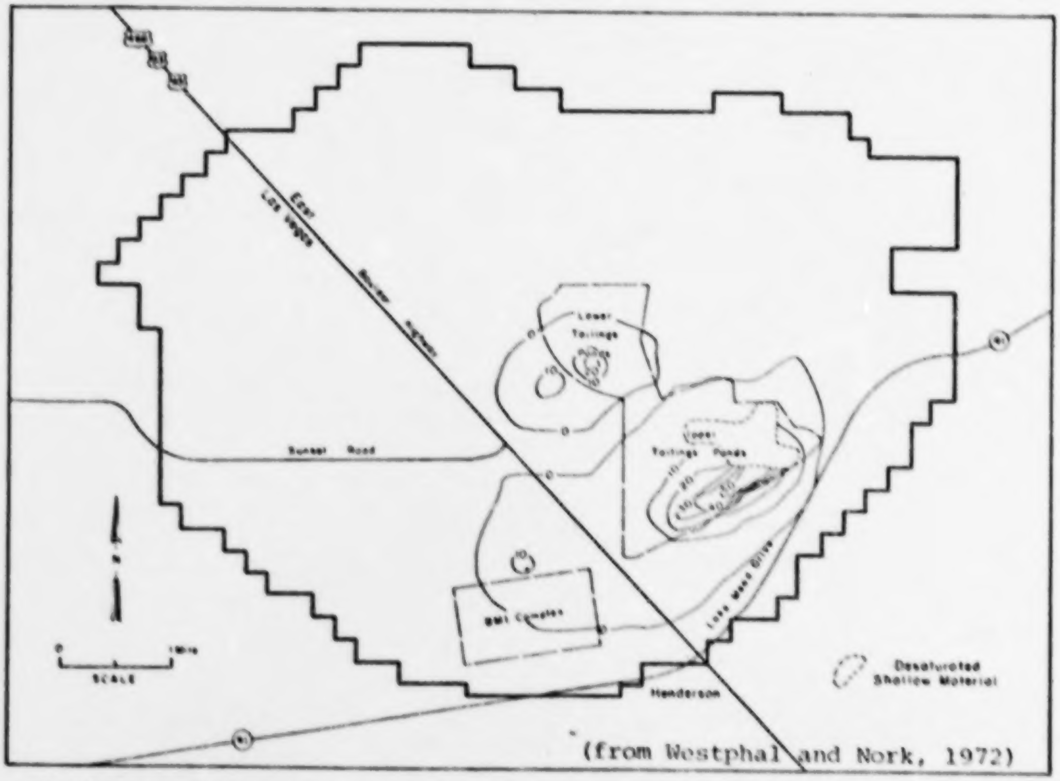
Average daily ground-water inflow equals (Total inflow ÷ # days in months considered minus other measurable inflows:

a) Above Pabco Road = 3.37 mgd
b) Below Pabco Road = 5.67 mgd
9.04 mgd


East Las Vegas
Boulder Highway
Sunset Road
Lower Tailings Ponds
Upper Tailings Ponds
BMI Complex
Lake Mead Drive
Henderson
Desaturated Shallow Material
0
1 Mile
SCALE
N
1520
1560
1580
1600
1620
1640
1660
1680
1700
1720
1740
1760
1800
1820
1840

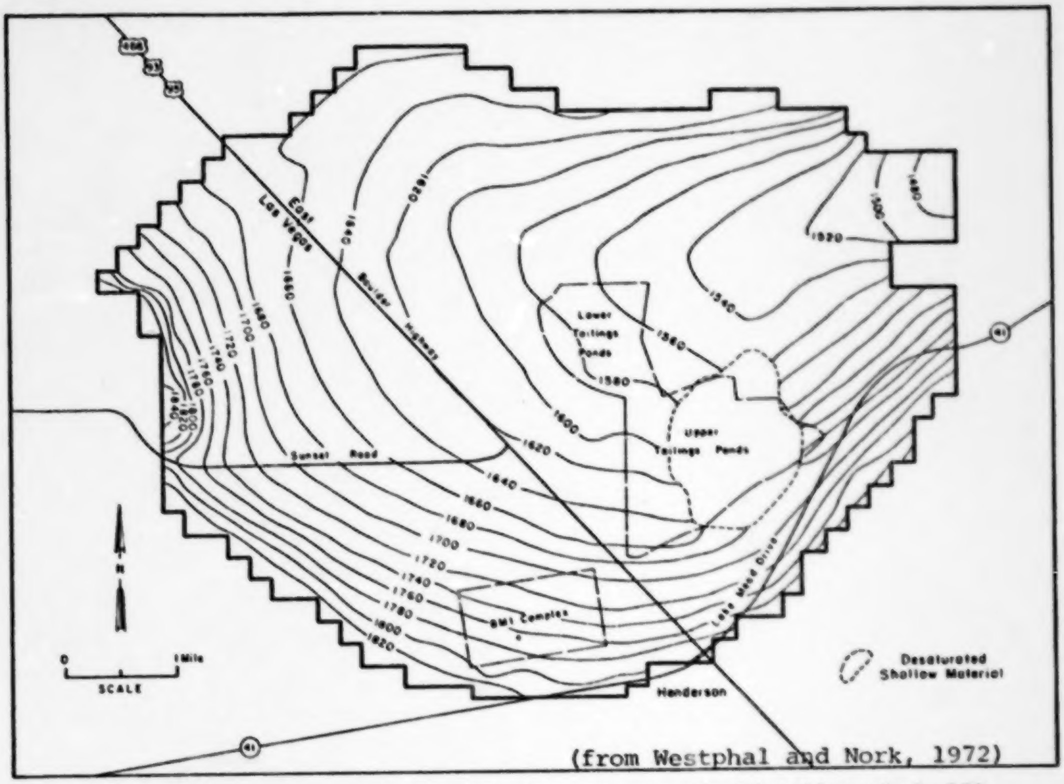
(from Westphal and Nork, 1972)

FIGURE 23 Simulated water levels in the shallow flow system at an elapsed time of 194 days for S = 0.20 (dashed line denotes desaturated materials).


East Las Vegas
Boulder Highway
Sunset Road
Lower Tailings Ponds
Upper Tailings Ponds
BMI Complex
Lake Mead Drive
Henderson
Desaturated Shallow Material
0
1 Mile
SCALE
N
0
10
20
30
40

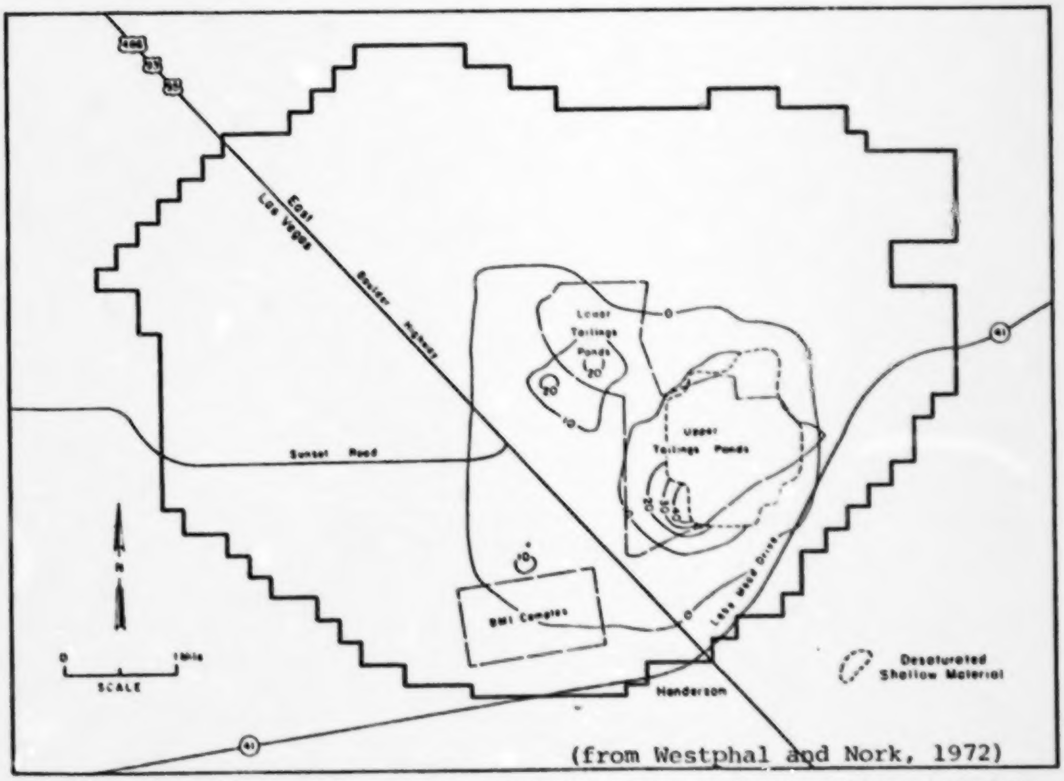
(from Westphal and Nork, 1972)

FIGURE 24. Simulated water level changes in the shallow flow system at an elapsed time of 194 days for S = 0.20 (dashed line denotes desaturated materials).


466
93
95
East Las Vegas
Boulder Highway
Lower Tailings Ponds
Upper Tailings Ponds
Sunset Road
Lake Mead Drive
BMI Complex
Henderson
41
1520
1540
1560
1580
1600
1620
1640
1660
1680
1700
1720
1740
1760
1780
1800
1820
0
1 Mile
SCALE
N
Desaturated Shallow Material

(from Westphal and Nork, 1972)

FIGURE 25. Simulated water levels in the shallow flow system at an elapsed time of 2 years for S = 0.20 (dashed line denotes desaturated materials).

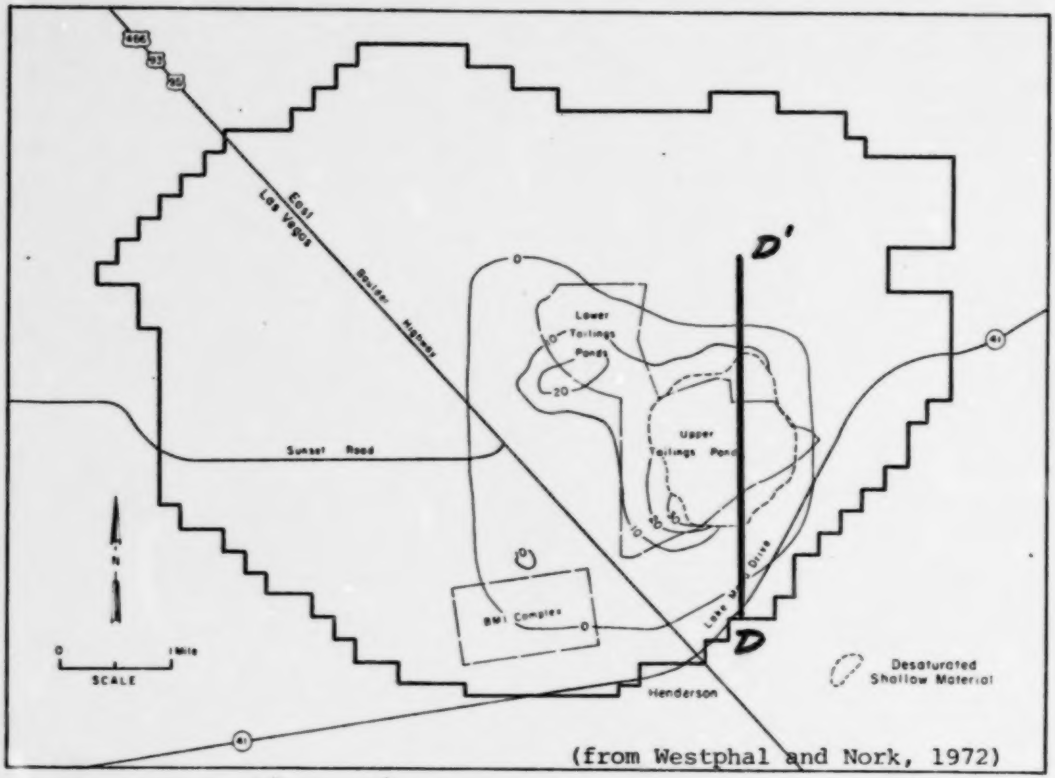

466
93
95
East Las Vegas
Boulder Highway
Lower Tailings Ponds
Upper Tailings Ponds
Sunset Road
Lake Mead Drive
BMI Complex
Henderson
41
0
10
20
30
0
1 Mile
SCALE
N
Desaturated Shallow Material

(from Westphal and Nork, 1972)

FIGURE 26. Simulated water-level changes in the shallow flow system at an elapsed time of 2 years for S = 0.20 (dashed line denotes desaturated materials).

ponds are slower to respond because a smaller volume of effluent infiltrates in that area and less potential for leakage into the low-yield sediments exists.

Very little change is indicated after six years elapsed time for S = 0.20 as shown in Figure 27. The approximate areal extent of the influence of effluent disposal on the shallow flow system is about 3,600 acres. Of the total, effluent from the upper ponds and the BMI complex appears to have an areal influence of about 2,500 acres.


466
93
95
East Las Vegas Boulder Highway
Sunset Road
Lower Tailings Ponds
Upper Tailings Ponds
BMI Complex
Lake Mead Drive
Henderson
41
D'
D
0
10
20
30
N
0
1 Mile
SCALE
Desaturated Shallow Material

(from Westphal and Nork, 1972)

Figure 27. Simulated water-level changes in the shallow flow system at an elapsed time of 6 years for S = 0.20 (dashed line denotes desaturated materials).

In the vicinity of the Wash it is difficult to assess rates of response which may be caused by cessation of effluent disposal in the ponds, particularly in the short term. Under the prevailing gradient (0.02 feet/foot), it would take approximately 3.5-5 years for effluent in the upper ponds to reach the Wash.

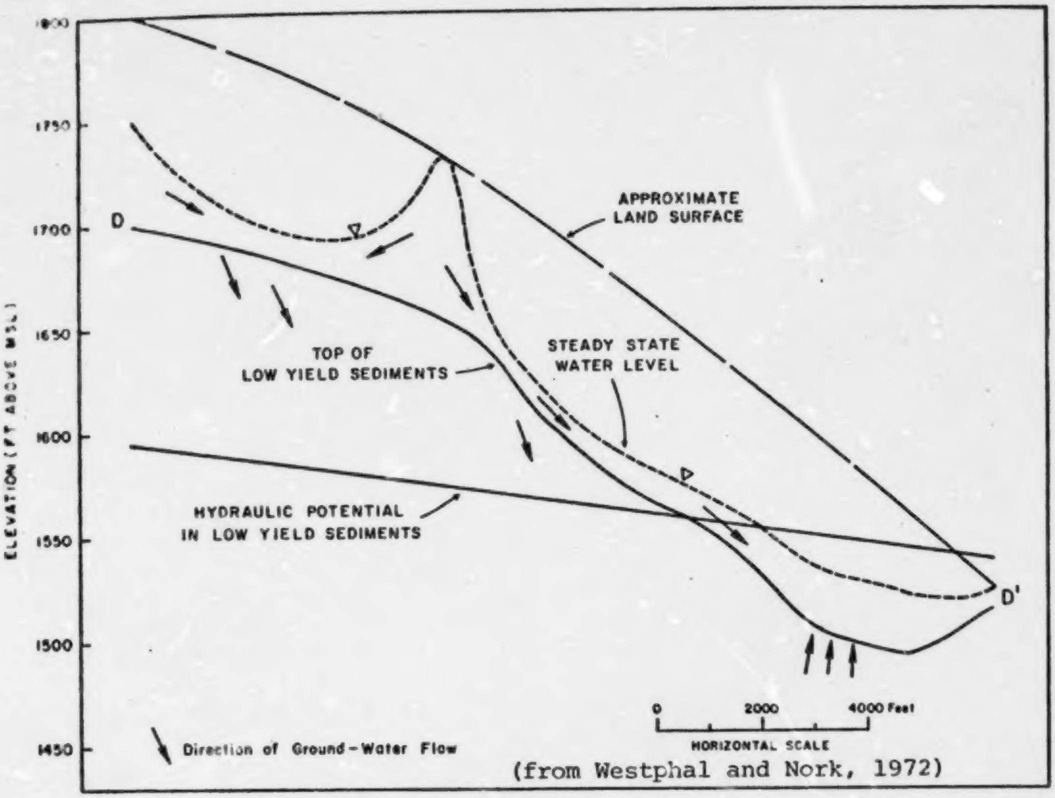
It would not necessarily take several years for flow in the Wash to be affected if disposal of effluent in the upper ponds were stopped. Primarily because of vertical leakage into low-yield sediments, gradients between the upper ponds and the Wash decline rapidly.

The areal extent of simulated responses in the lower ponds is less and responses occur more slowly. First water-level changes are not noticeable 70 days after removal of the effluent stress. The influence gradually expands for approximately two years after which changes are not readily discernible in map presentations at the scale used in this report. First signs of diminished spring discharge also occur after two years. Approximately 0.23 mgd percolate into low-yield sediments beneath the lower ponds. The remaining 1.2 mgd flows toward the Wash. The time of travel under the prevailing gradient (0.15 feet/foot) is about 5 to 7 months.

Distribution of water levels directly upgradient from the desaturated zone in the area of the upper ponds indicates underflow across the boundary in this area percolates into the low-yield sediments prior to reaching the ponds. Therefore, it can be inferred that 1) boundary conditions south of the evaporation ponds are significantly affected by effluent disposal in the ponds, and 2) the specified configuration of deep potentials is unrealistic in that area. If vertical leakage were reduced, more underflow would reach the pond area and would result in less effluent leaking into low-yield sediments.

Figure 28 shows a cross-section of shallow, saturated materials taken between the upper tailing ponds and Las Vegas Wash (location shown on Figure 27). Also shown are potentials in the low-yield sediments and arrows depicting probable directions of ground-water flow. About 3,000 feet south of the Wash at an elevation of 1,550 feet above mean sea level, hydraulic potentials in the deep and shallow systems are equal. South of this point, some groundwater moves downward across the surface of low-yield sediments while north of this point ground-water transfer between systems is reversed.

Although Figure 28 shows a qualitative relationship between the shallow flow system and flow conditions at the contact with low-yield sediments, the primary purpose is to show the vertical extent of the shallow flow system. Because this cross-section is representative of conditions between the upper tailing ponds and Las Vegas Wash, it can be inferred the average saturated thickness is about 30 feet and the depth to water ranges from approximately land surface to about 50 feet below land surface. From the location of the trough between the southern boundary and the mound, it can be seen the presence of wastewaters infiltrating from the upper ponds is indicated as far as 2,300 feet south of the ponds. It also appears ground water in saturated materials downgradient from the mound is derived principally from percolation of effluent from the upper ponds.



(from Westphal and Nork, 1972)

Figure 28. Cross section of the shallow flow system showing simulated steady-state water levels, top of the low-yield sediments, hydraulic potentials in the low yield sediments, and approximate direction of ground-water flow (dashed line denotes desaturated materials).

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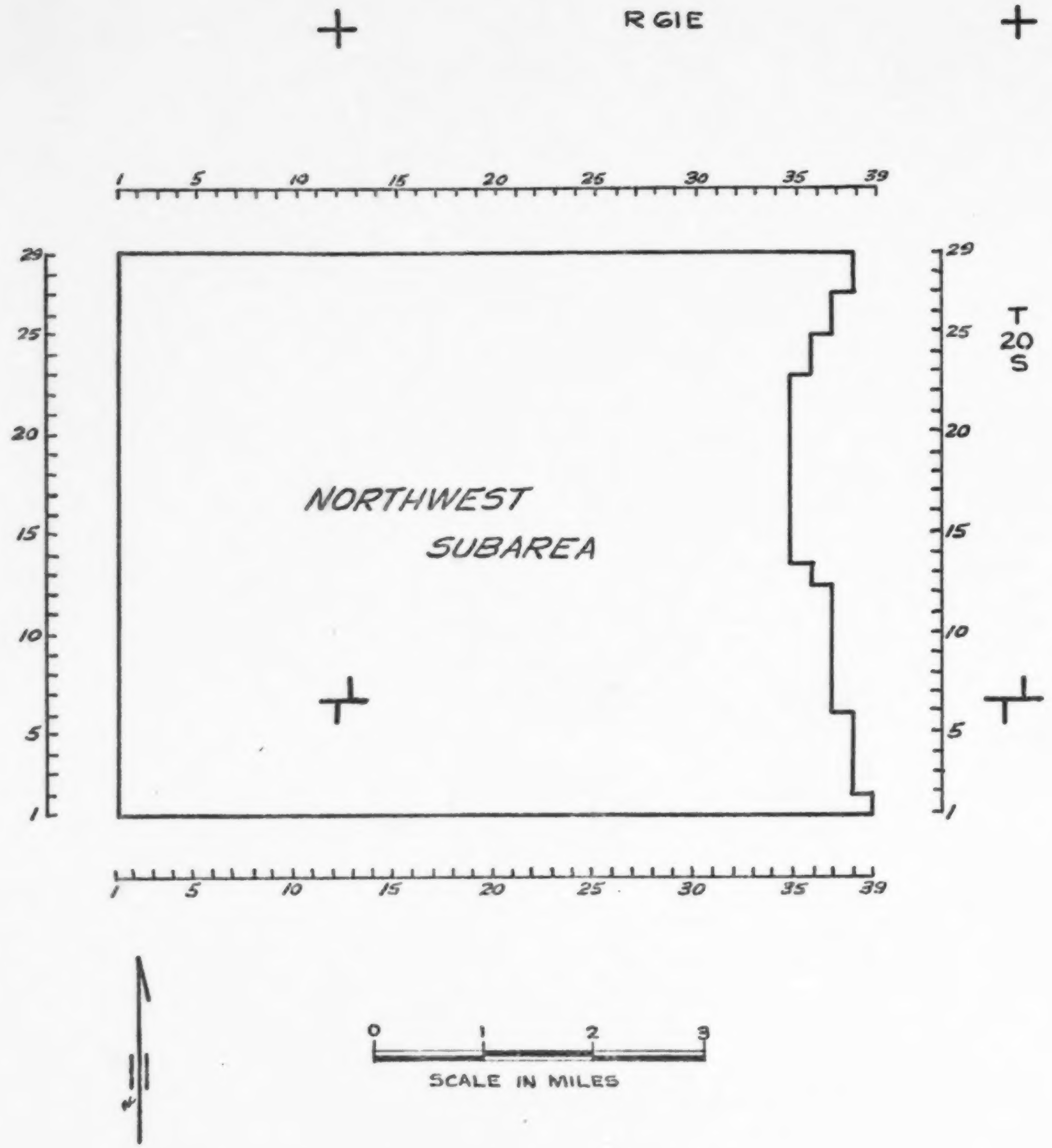
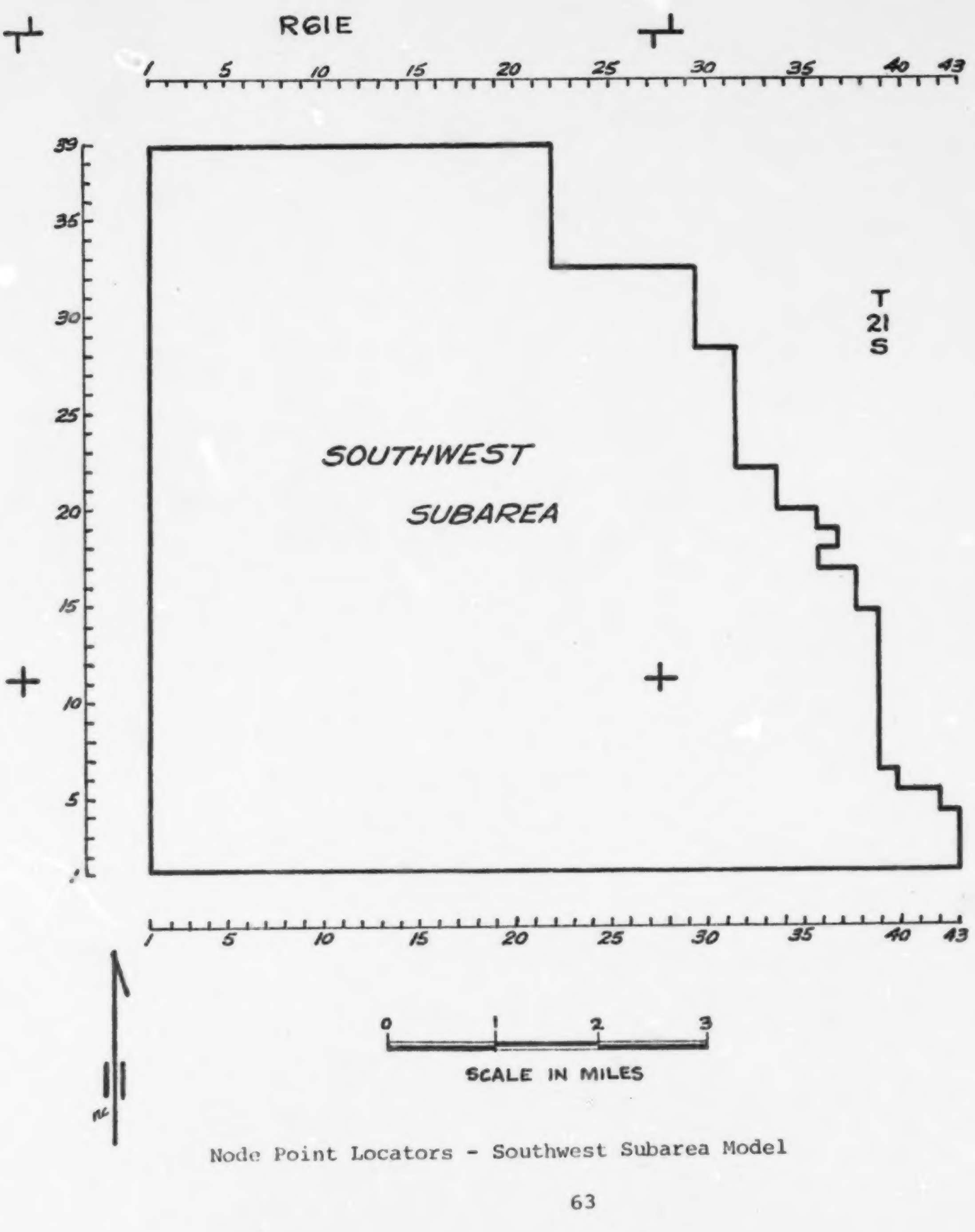
Appendix 1. Nodal recharge and discharge values as used in simulation models.

EXPLANATION

This appendix lists recharge and discharge values by node (column and row designation) as used in simulation modeling of the northwest subarea, southwest subarea, and northeast subarea. Row and column locations are shown for each subarea in the figures which follow. Recharge and discharge values were derived from water budgeting procedures as described by Patt (1976). For use in the models, the recharge and/or discharge at each node due to irrigation, phreatophyte consumption (northeast subarea only), evapotranspiration, and pumpage from shallow domestic wells, was summed to provide a net value for each node. Recharge/discharge values in this appendix are in gallons per minute (gal/min).

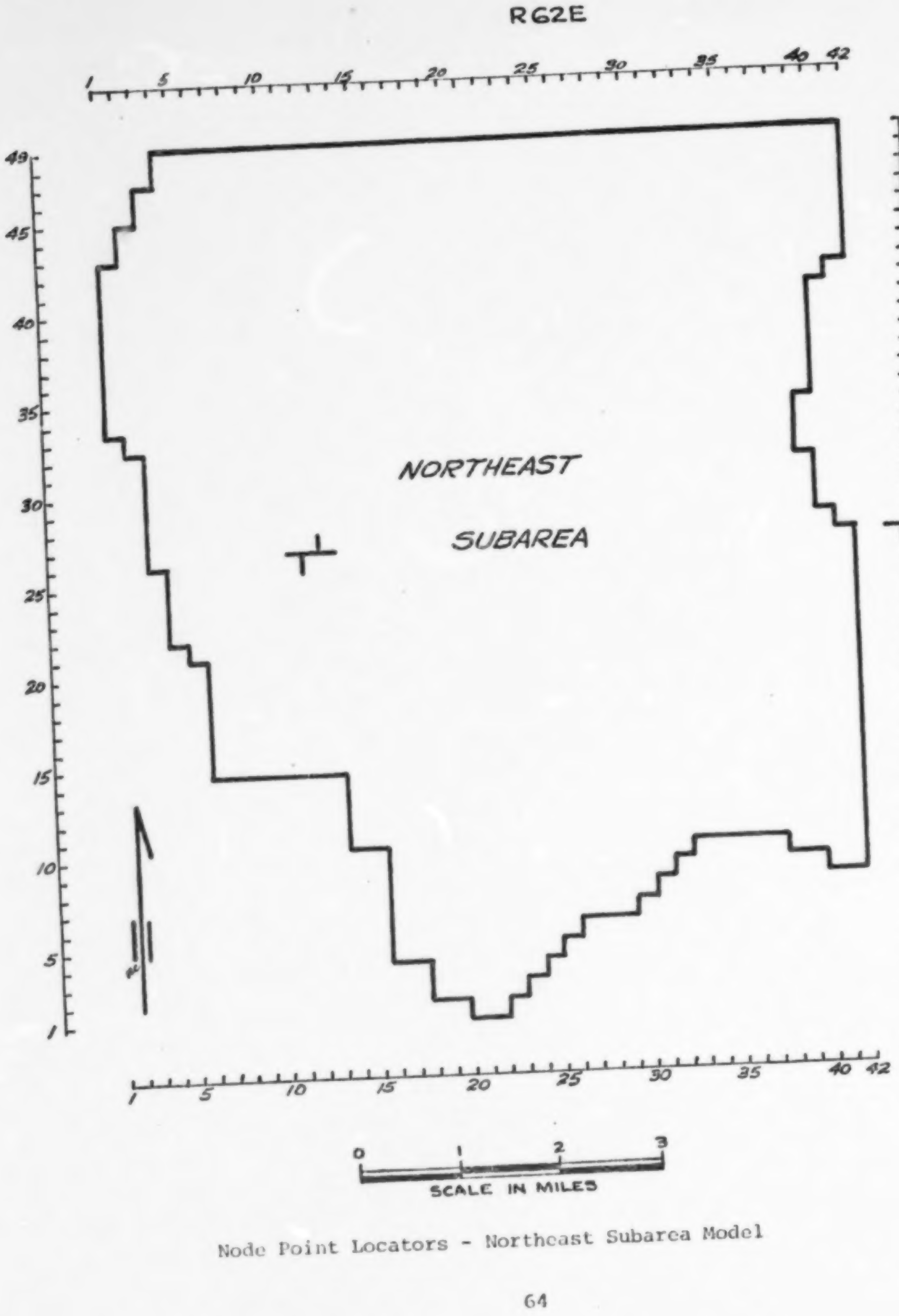

R 61E
T
20
S
NORTHWEST
SUBAREA
1
5
10
15
20
25
29
30
35
39
0
1
2
3
SCALE IN MILES

Node Point Locators - Northwest Subarea Model



R61E
T
21
S
SOUTHWEST
SUBAREA
1
5
10
15
20
25
30
35
39
40
43
0
1
2
3
SCALE IN MILES
N

Node Point Locators - Southwest Subarea Model


R62E
1
5
10
15
20
25
30
35
40
42
T
20
S
T
21
S
49
45
40
35
30
25
20
15
10
5
1
NORTHEAST
SUBAREA
0
1
2
3
SCALE IN MILES

Node Point Locators - Northeast Subarea Model

Part 1. Northwest Subarea - recharge in gal/min.

Col.	Row	1972	1965	1958	1950	1943
1	1	0	0	0	0	0
1	2	0	0	0	0	0
1	3	0	0	0	0	0
1	4	0	0	0	0	0
1	5	0	0	0	0	0
1	6	0	0	0	0	0
1	7	0	0	0	0	0
1	8	0	0	0	0	0
1	9	0	0	0	0	0
1	10	0	0	0	0	0
1	11	4.7	0	0	0	0
1	12	0	0	0	0	0
1	13	0	0	0	0	0
1	14	0	0	0	0	0
1	15	0	0	0	0	0
1	16	0	0	0	0	0
1	17	0	0	0	0	0
1	18	0	0	0	0	0
1	19	0	0	0	0	0
1	20	0	0	0	0	0
1	21	0	0	0	0	0
1	22	0	0	0	0	0
1	23	0	0	0	0	0
1	24	0	0	0	0	0
1	25	0	0	0	0	0
1	26	0	0	0	0	0
1	27	0	0	0	0	0
1	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
2	1	0	0	0	0	0
2	2	0	0	0	0	0
2	3	0	0	0	0	0
2	4	0	0	0	0	0
2	5	.3	.3	0	0	0
2	6	.3	.3	0	0	0
2	7	3.1	3.1	0	0	0
2	8	15.5	7.7	0	0	0
2	9	8.9	6.0	0	0	0
2	10	0	0	0	0	0
2	11	0	0	0	0	0
2	12	0	0	0	0	0
2	13	0	0	0	0	0
2	14	0	0	0	0	0
2	15	0	0	0	0	0
2	16	0	0	0	0	0
2	17	0	0	0	0	0
2	18	0	0	0	0	0
2	19	0	0	0	0	0
2	20	0	0	0	0	0
2	21	0	0	0	0	0
2	22	0	0	0	0	0
2	23	0	0	0	0	0
2	24	0	0	0	0	0
2	25	0	0	0	0	0
2	26	0	0	0	0	0
2	27	0	0	0	0	0
2	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
3	1	0	0	0	0	0
3	2	0	0	0	0	0
3	3	0	0	0	0	0
3	4	0	0	0	0	0
3	5	0	0	0	0	0
3	6	0	0	0	0	0
3	7	8.9	8.9	0	0	0
3	8	16.3	16.3	0	0	0
3	9	8.9	8.9	0	0	0
3	10	0	0	0	0	0
3	11	8.7	8.7	0	0	0
3	12	21.0	16.1	0	0	0
3	13	8.3	.4	0	0	0
3	14	0	0	0	0	0
3	15	0	0	0	0	0
3	16	0	0	0	0	0
3	17	0	0	0	0	0
3	18	0	0	0	0	0
3	19	0	0	0	0	0
3	20	0	0	0	0	0
3	21	0	0	0	0	0
3	22	0	0	0	0	0
3	23	0	0	0	0	0
3	24	0	0	0	0	0
3	25	0	0	0	0	0
3	26	0	0	0	0	0
3	27	0	0	0	0	0
3	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
4	1	0	0	0	0	0
4	2	0	0	0	0	0
4	3	0	0	0	0	0
4	4	0	0	0	0	0
4	5	0	0	0	0	0
4	6	0	0	0	0	0
4	7	8.9	8.9	0	0	0
4	8	43.1	43.1	0	0	0
4	9	13.4	13.4	0	0	0
4	10	8.9	8.9	0	0	0
4	11	6.2	6.2	0	0	0
4	12	1.8	1.8	0	0	0
4	13	13.8	13.8	0	0	0
4	14	7.4	7.4	0	0	0
4	15	0	0	0	0	0
4	16	0	0	0	0	0
4	17	.9	.4	.4	.4	0
4	18	0	0	0	0	0
4	19	0	0	0	0	0
4	20	0	0	0	0	0
4	21	0	0	0	0	0
4	22	0	0	0	0	0
4	23	0	0	0	0	0
4	24	0	0	0	0	0
4	25	0	0	0	0	0
4	26	0	0	0	0	0
4	27	0	0	0	0	0
4	28	.2	.2	0	0	0

Col.	Row	1972	1965	1958	1950	1943
5	1	0	0	0	0	0
5	2	0	0	0	0	0
5	3	0	0	0	0	0
5	4	0	0	0	0	0
5	5	0	0	0	0	0
5	6	0	0	0	0	0
5	7	13.3	13.3	0	0	0
5	8	17.8	17.8	0	0	0
5	9	17.8	17.8	0	0	0
5	10	17.8	17.8	0	0	0
5	11	14.6	14.6	0	0	0
5	12	1.0	1.0	0	0	0
5	13	17.5	17.5	0	0	0
5	14	10.1	10.1	0	0	0
5	15	0	0	0	0	0
5	16	0	0	0	0	0
5	17	0	0	0	0	0
5	18	0	0	0	0	0
5	19	0	0	0	0	0
5	20	0	0	0	0	0
5	21	0	0	0	0	0
5	22	0	0	0	0	0
5	23	6.2	0	0	0	0
5	24	0	0	0	0	0
5	25	0	0	0	0	0
5	26	0	0	0	0	0
5	27	0	0	0	0	0
5	28	0	0	0	0	0

	1972	1965	1958	1950	1943
[illegible]	.3	.3	0	0	0
[illegible]	1.0	1.0	0	0	0
[illegible]	1.0	0	0	0	0
[illegible]	0	0	0	0	0
[illegible]	.6	.6	0	0	0
[illegible]	5.0	5.0	0	0	0
[illegible]	14.6	14.6	0	0	0
[illegible]	17.8	17.8	0	0	0
[illegible]	14.6	14.6	0	0	0
[illegible]	18.7	18.7	0	0	0
[illegible]	15.2	15.2	0	0	0
[illegible]	3.1	3.1	0	0	0
[illegible]	17.8	17.8	0	0	0
[illegible]	15.6	15.6	0	0	0
[illegible]	0	0	0	0	0
[illegible]	0	0	0	0	0
[illegible]	0	0	0	0	0
[illegible]	0	0	0	0	0
[illegible]	0	0	0	0	0
[illegible]	0	0	0	0	0
[illegible]	0	0	0	0	0
[illegible]	0	0	0	0	0
[illegible]	34.7	0	0	0	0
[illegible]	0	0	0	0	0
[illegible]	0	0	0	0	0
[illegible]	0	0	0	0	0
[illegible]	0	0	0	0	0
[illegible]	1.5	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
7	1	.3	0	0	0	0
7	2	1.6	1.6	0	0	0
7	3	.7	.7	0	0	0
7	4	.4	.4	0	0	0
7	5	0	0	0	0	0
7	6	.6	.4	0	0	0
7	7	3.9	3.9	0	0	0
7	8	13.1	13.1	0	0	0
7	9	15.6	15.6	0	0	0
7	10	17.9	17.9	0	0	0
7	11	16.0	16.0	0	0	0
7	12	6.7	6.7	0	0	0
7	13	4.2	4.2	0	0	0
7	14	16.3	16.3	0	0	0
7	15	14.4	14.4	0	0	0
7	16	18.4	18.4	0	0	0
7	17	8.2	8.2	0	0	0
7	18	13.4	13.4	0	0	0
7	19	1.9	1.9	0	0	0
7	20	0	0	0	0	0
7	21	9.3	2.6	0	0	0
7	22	4.7	.4	0	0	0
7	23	0	0	0	0	0
7	24	3.9	2.6	0	0	0
7	25	2.9	2.9	0	0	0
7	26	0	0	0	0	0
7	27	1.9	0	0	0	0
7	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
8	1	.3	.3	0	0	0
8	2	.3	.3	0	0	0
8	3	4.1	1.2	0	0	0
8	4	.3	.3	0	0	0
8	5	2.3	2.3	0	0	0
8	6	1.9	1.9	0	0	0
8	7	.7	.6	0	0	0
8	8	21.8	21.8	0	0	0
8	9	18.4	18.4	0	0	0
8	10	18.4	18.4	0	0	0
8	11	17.8	17.8	0	0	0
8	12	13.4	13.4	0	0	0
8	13	13.4	13.4	0	0	0
8	14	7.4	7.4	0	0	0
8	15	16.0	16.0	0	0	0
8	16	11.7	11.7	0	0	0
8	17	5.7	5.7	0	0	0
8	18	5.4	5.4	0	0	0
8	19	1.2	1.2	0	0	0
8	20	0	0	0	0	0
8	21	15.6	16.6	0	0	0
8	22	3.1	0	0	0	0
8	23	0	0	0	0	0
8	24	5.1	5.1	0	0	0
8	25	8.8	5.5	0	0	0
8	26	0	0	0	0	0
8	27	0	0	0	0	0
8	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
9	1	0	0	0	0	0
9	2	1.0	0	0	0	0
9	3	2.3	2.3	0	0	0
9	4	4.2	2.6	0	0	0
9	5	10.4	10.4	0	0	0
9	6	3.1	3.1	0	0	0
9	7	1.5	1.5	0	0	0
9	8	17.8	8.9	0	0	0
9	9	14.9	14.9	0	0	0
9	10	19.7	19.7	0	0	0
9	11	10.8	10.8	0	0	0
9	12	6.2	6.2	0	0	0
9	13	8.2	8.2	0	0	0
9	14	5.8	5.8	0	0	0
9	15	7.4	7.4	0	0	0
9	16	8.5	8.5	0	0	0
9	17	6.9	6.9	0	0	0
9	18	7.9	7.9	4.4	0	0
9	19	4.1	4.1	4.1	1.0	0
9	20	9.5	9.5	.9	2.3	0
9	21	15.9	15.9	0	0	0
9	22	7.3	7.3	0	0	0
9	23	0	0	14.1	14.1	14.1
9	24	4.4	4.4	14.1	14.1	14.1
9	25	3.2	3.2	0	0	0
9	26	0	0	0	0	0
9	27	0	0	0	0	0
9	28	5.0	5.0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
10	1	1.0	0	0	0	0
10	2	0	0	0	0	0
10	3	1.0	1.0	0	0	0
10	4	11.7	4.5	0	0	0
10	5	17.8	17.8	0	0	0
10	6	8.9	8.9	0	0	0
10	7	0	0	0	0	0
10	8	16.9	8.9	0	0	0
10	9	8.9	8.9	0	0	0
10	10	8.9	8.9	0	0	0
10	11	0	0	0	0	0
10	12	0	0	0	0	0
10	13	7.4	0	0	0	0
10	14	17.8	17.8	0	0	0
10	15	18.1	18.1	0	0	0
10	16	14.7	14.7	0	0	0
10	17	1.9	1.2	.4	.4	0
10	18	1.5	1.5	0	0	0
10	19	10.2	7.7	0	0	0
10	20	17.9	17.9	1.2	0	0
10	21	17.4	17.4	1.2	0	0
10	22	3.9	3.9	14.1	14.1	14.1
10	23	1.8	1.8	14.1	14.1	14.1
10	24	0	0	.3	.3	0
10	25	0	0	0	0	0
10	26	0	0	0	0	0
10	27	0	0	0	0	0
10	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
11	1	0	0	0	0	0
11	2	0	0	0	0	0
11	3	0	0	0	0	0
11	4	9.5	.4	0	0	0
11	5	15.8	15.8	0	0	0
11	6	7.1	7.1	0	0	0
11	7	0	0	0	0	0
11	8	8.2	4.5	0	0	0
11	9	4.5	4.5	0	0	0
11	10	0	0	0	0	0
11	11	7.3	0	0	0	0
11	12	12.5	12.5	0	0	0
11	13	16.9	16.9	0	0	0
11	14	17.9	17.9	0	0	0
11	15	17.8	17.8	0	0	0
11	16	12.4	12.4	0	0	0
11	17	3.8	3.8	0	.9	0
11	18	2.5	2.5	0	.4	0
11	19	.9	.9	.9	.9	0
11	20	12.1	5.4	1.2	0	0
11	21	12.1	12.1	1.3	0	0
11	22	10.2	10.2	1.2	0	0
11	23	11.1	6.2	2.6	2.6	0
11	24	1.5	1.5	.6	.6	0
11	25	1.5	0	.6	.6	0
11	26	1.3	1.3	1.3	1.3	0
11	27	1.3	0	0	0	0
11	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
12	1	0	0	0	0	0
12	2	0	0	0	0	0
12	3	0	0	0	0	0
12	4	0	0	0	0	0
12	5	0	0	0	0	0
12	6	0	0	0	0	0
12	7	9.0	9.0	0	0	0
12	8	9.0	9.0	0	0	0
12	9	2.6	2.6	0	0	0
12	10	0	0	0	0	0
12	11	1.5	0	0	0	0
12	12	19.5	19.5	0	0	0
12	13	8.8	8.8	0	0	0
12	14	6.0	6.0	0	0	0
12	15	22.7	22.7	22.7	22.7	22.7
12	16	11.3	11.3	11.3	11.3	11.3
12	17	.6	.6	.6	.6	0
12	18	5.8	5.8	1.0	1.0	0
12	19	1.0	1.0	1.0	0	0
12	20	3.6	3.6	1.6	0	0
12	21	7.9	7.9	1.6		0
12	22	4.1	2.0	1.6	0	0
12	23	3.6	3.6	2.2	0	0
12	24	.7	.7	.3	.3	.3
12	25	0	0	0	0	0
12	26	10.8	10.8	0	0	0
12	27	0	0	0	0	0
12	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
13	1	1.2	1.2	0	0	0
13	2	0	0	0	0	0
13	3	7.0	7.0	0	0	0
13	4	8.2	8.2	0	0	0
13	5	5.7	2.9	0	0	0
13	6	0	0	0	0	0
13	7	13.4	13.4	0	0	0
13	8	38.8	38.8	0	0	0
13	9	17.5	17.5	0	0	0
13	10	17.8	17.8	0	0	0
13	11	2.0	0	0	0	0
13	12	59.5	0	0	0	0
13	13	1.3	1.3	0	0	0
13	14	.9	.9	0	0	0
13	15	24.0	24.0	24.0	24.0	24.0
13	16	22.0	22.0	22.0	22.0	22.0
13	17	12.0	12.0	12.0	12.0	12.0
13	18	5.0	5.0	5.0	0	0
13	19	0	0	0	0	0
13	20	2.8	2.8	2.0	0	0
13	21	4.8	4.8	2.9	0	0
13	22	0	0	0	0	0
13	23	0	0	0	0	0
13	24	0	0	0	0	0
13	25	0	0	0	0	0
13	26	0	0	0	0	0
13	27	0	0	0	0	0
13	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
14	1	8.3	8.3	0	0	11.8
14	2	12.7	12.7	0	0	11.8
14	3	17.1	17.1	0	0	11.8
14	4	11.2	11.2	1.8	1.8	0
14	5	11.7	11.7	5.1	5.1	0
14	6	5.4	5.4	3.8	3.8	0
14	7	13.4	13.4	13.4	0	0
14	8	16.0	16.0	16.0	0	0
14	9	16.9	16.9	16.9	0	0
14	10	11.7	11.7	11.7	0	0
14	11	0	0	0	0	0
14	12	0	0	0	0	0
14	13	10.1	10.1	0	0	0
14	14	9.6	9.6	0	0	0
14	15	22.8	22.8	22.8	22.8	22.8
14	16	22.0	22.0	22.0	22.0	22.8
14	17	9.3	9.3	8.3	8.3	22.8
14	18	8.3	8.3	0	0	0
14	19	1.8	1.8	0	0	0
14	20	14.0	14.0	0	0	0
14	21	8.6	8.6	0	0	0
14	22	2.2	0	0	0	0
14	23	0	0	0	0	0
14	24	0	0	0	0	0
14	25	0	0	0	0	0
14	26	0	0	0	0	0
14	27	0	0	0	0	0
14	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
15	1	11.7	11.2	0	0	11.8
15	2	17.5	17.5	0	0	11.8
15	3	22.6	22.6	0	0	11.8
15	4	9.5	9.5	.9	.9	0
15	5	3.8	3.8	1.9	1.9	0
15	6	1.2	1.2	0	0	0
15	7	23.5	23.2	0	0	0
15	8	32.4	31.4	0	0	0
15	9	1.5	.4	0	0	0
15	10	1.9	.4	0	0	0
15	11	0	0	0	0	0
15	12	0	0	0	0	0
15	13	8.6	8.6	0	0	0
15	14	5.5	5.5	0	0	0
15	15	14.7	14.7	14.0	14.0	14.0
15	16	10.0	10.0	10.0	10.0	10.0
15	17	6.4	6.5	5.8	4.3	4.3
15	18	7.9	7.9	2.0	0	0
15	19	2.0	2.0	1.0	0	0
15	20	7.9	7.9	0	0	0
15	21	0	0	0	0	0
15	22	0	0	0	0	0
15	23	0	0	0	0	0
15	24	0	0	0	0	0
15	25	0	0	0	0	0
15	26	0	0	0	0	0
15	27	0	0	0	0	0
15	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
16	1	4.5	4.5	0	0	0
16	2	10.1	10.1	0	0	0
16	3	5.7	5.7	0	0	0
16	4	8.6	8.6	0	0	0
16	5	.9	.9	0	0	0
16	6	0	0	0	0	0
16	7	5.0	5.0	0	0	0
16	8	2.5	2.5	0	0	0
16	9	0	0	0	0	0
16	10	0	0	0	0	0
16	11	0	0	0	0	0
16	12	0	0	0	0	0
16	13	5.6	5.6	5.6	0	0
16	14	13.4	13.4	13.4	0	0
16	15	2.5	3.5	3.5	.4	0
16	16	7.4	7.4	7.4	6.4	6.4
16	17	9.3	9.3	9.3	7.0	7.0
16	18	6.7	6.7	6.7	1.8	1.8
16	19	12.0	12.0	12.0	3.6	0
16	20	0	0	0	0	0
16	21	0	0	0	0	0
16	22	0	0	0	0	0
16	23	0	0	0	0	0
16	24	0	0	0	0	0
16	25	0	0	0	0	0
16	26	0	0	0	0	0
16	27	0	0	0	0	0
16	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
17	1	0	0	0	0	0
17	2	0	0	0	0	0
17	3	2.2	0	0	0	0
17	4	13.1	13.1	13.1	0	0
17	5	17.8	17.8	17.8	3.2	0
17	6	17.8	17.8	17.8	12.4	0
17	7	4.7	4.7	4.7	.7	0
17	8	1.2	1.2	1.2	0	0
17	9	1.5	1.5	1.5	0	0
17	10	0	0	0	0	0
17	11	0	0	0	0	0
17	12	0	0	0	0	0
17	13	7.4	7.4	7.4	0	0
17	14	17.8	17.8	17.8	.7	0
17	15	15.9	15.9	15.9	0	0
17	16	13.4	13.4	13.4	0	0
17	17	6.2	6.2	6.2	4.5	3.1
17	18	6.6	6.6	6.6	6.1	3.8
17	19	0	0	0	0	0
17	20	0	0	0	0	0
17	21	0	0	0	.6	0
17	22	0	0	0	0	0
17	23	0	0	0	0	0
17	24	0	0	0	0	0
17	25	0	0	0	0	0
17	26	0	0	0	0	0
17	27	0	0	0	0	0
17	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
18	1	7.3	7.3	0	0	0
18	2	0	0	0	0	0
18	3	0	0	0	0	0
18	4	3.5	3.5	0	0	0
18	5	6.7	6.7	0	0	0
18	6	7.9	7.9	1.5	2.0	0
18	7	11.1	11.1	2.6	2.6	0
18	8	5.6	5.6	0	0	0
18	9	6.0	6.0	0	0	0
18	10	9.2	9.2	0	0	0
18	11	7.4	7.4	0	0	0
18	12	0	0	0	0	0
18	13	7.9	7.9	0	0	0
18	14	1.3	1.3	1.3	1.3	0
18	15	16.0	16.0	16.0	16.0	16.0
18	16	14.0	14.0	14.0	0	0
18	17	11.2	11.2	11.2	0	0
18	18	3.4	3.4	3.4	2.6	0
18	19	3.5	3.5	11.8	11.8	11.8
18	20	2.5	2.5	11.8	11.8	11.8
18	21	0	0	0	0	0
18	22	0	0	0	0	0
18	23	0	0	0	0	0
18	24	0	0	0	0	0
18	25	0	0	0	0	0
18	26	0	0	0	0	0
18	27	0	0	0	0	0
18	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
19	1	9.6	9.6	0	0	0
19	2	1.5	8.5	0	0	0
19	3	0	0	0	0	0
19	4	5.8	5.8	.4	.4	0
19	5	14.6	14.6	0	0	0
19	6	12.4	12.4	4.5	4.5	0
19	7	1.6	1.6	1.6	1.0	0
19	8	2.3	2.3	2.3	2.3	0
19	9	8.3	8.3	8.3	1.9	0
19	10	6.0	6.0	6.0	0	0
19	11	26.8	26.8	26.8	0	0
19	12	0	0	0	0	0
19	13	7.4	7.4	7.4	0	0
19	14	31.1	31.1	10.0	10.0	10.0
19	15	16.3	16.3	16.3	3.1	3.1
19	16	17.8	17.8	17.8	0	0
19	17	7.6	7.6	7.6	0	0
19	18	1.5	1.5	1.5	.7	0
19	19	2.2	2.2	11.8	11.8	11.8
19	20	2.3	2.3	11.8	11.8	11.8
19	21	0	0	0	0	0
19	22	0	0	0	0	0
19	23	0	0	0	0	0
19	24	0	0	0	0	0
19	25	0	0	0	0	0
19	26	0	0	0	0	0
19	27	0	0	0	0	0
19	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
20	1	4.5	4.5	0	0	0
20	2	0	0	0	0	0
20	3	0	0	0	0	0
20	4	7.4	7.4	0	0	0
20	5	16.3	16.3	0	0	0
20	6	20.1	20.1	6.1	6.1	0
20	7	10.1	10.1	5.5	4.5	0
20	8	10.1	10.1	3.9	3.9	0
20	9	13.4	13.4	13.4	0	0
20	10	12.7	12.7	11.8	11.8	11.8
20	11	10.6	10.6	9.4	9.4	9.4
20	12	6.0	6.0	6.0	.4	0
20	13	8.9	8.9	8.9	0	0
20	14	0	0	0	0	0
20	15	.9	.9	.9	0	0
20	16	8.5	8.5	8.5	0	0
20	17	6.0	6.0	6.0	0	0
20	18	0	0	0	0	0
20	19	0	0	0	0	0
20	20	1.8	1.8	1.8	0	0
20	21	0	0	0	0	0
20	22	0	0	0	0	0
20	23	0	0	0	0	0
20	24	0	0	0	0	0
20	25	0	0	0	0	0
20	26	0	0	0	0	0
20	27	0	0	0	0	0
20	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
21	1	0	0	0	0	0
21	2	0	0	0	0	0
21	3	0	0	0	0	0
21	4	11.5	11.5	0	0	0
21	5	23.8	23.8	0	0	0
21	6	19.3	19.3	0	0	0
21	7	.7	.7	.7	.7	0
21	8	2.8	2.8	2.6	2.6	0
21	9	6.4	6.4	4.5	4.5	0
21	10	14.9	14.9	7.0	7.0	7.0
21	11	.7	0	4.7	4.7	4.8
21	12	8.9	8.9	.9	.9	0
21	13	4.1	.4	.4	.4	0
21	14	2.5	0	0	0	0
21	15	0	0	0	0	0
21	16	1.3	0	0	0	0
21	17	0	0	0	0	0
21	18	0	0	0	0	0
21	19	0	0	0	0	0
21	20	0	0	0	0	0
21	21	0	0	0	0	0
21	22	0	0	0	0	0
21	23	0	0	0	0	0
21	24	4.2	0	0	0	0
21	25	2.0	0	0	0	0
21	26	0	0	0	0	0
21	27	0	0	0	0	0
21	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
22	1	0	0	0	0	0
22	2	4.4	4.4	4.4	0	0
22	3	17.5	17.5	17.5	0	0
22	4	7.6	7.6	7.6	0	0
22	5	9.9	9.9	3.1	3.1	0
22	6	7.7	7.7	4.5	4.5	0
22	7	.9	.9	.9	.9	0
22	8	1.2	1.2	11.8	11.8	11.8
22	9	7.0	7.0	7.1	7.1	7.1
22	10	15.8	15.8	0	0	0
22	11	12.0	12.0	0	0	0
22	12	0	0	0	0	0
22	13	1.2	1.2	1.2	2.6	2.6
22	14	4.2	4.2	4.2	.7	.7
22	15	8.9	8.9	8.9	.4	0
22	16	16.9	16.9	11.9	0	0
22	17	7.4	7.4	0	0	0
22	18	8.5	8.5	0	0	0
22	19	4.1	4.1	0	0	0
22	20	0	0	0	0	0
22	21	1.2	1.2	0	0	0
22	22	0	0	0	0	0
22	23	.4	0	0	0	0
22	24	11.5	8.2	0	0	0
22	25	15.7	1.6	0	0	0
22	26	0	0	0	0	0
22	27	0	0	0	0	0
22	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
23	1	0	0	0	0	0
23	2	1.5	1.5	0	0	0
23	3	15.7	15.7	0	0	0
23	4	12.7	12.7	0	0	0
23	5	13.4	13.4	5.0	5.0	5.0
23	6	6.4	6.4	6.4	6.4	0
23	7	8.6	8.6	8.6	8.6	0
23	8	4.5	4.5	7.9	7.9	7.9
23	9	7.3	7.3	4.1	4.1	4.1
23	10	6.0	6.0	2.9	2.9	0
23	11	17.8	17.8	0	0	0
23	12	15.2	15.2	0	0	0
23	13	6.4	6.4	1.2	1.2	1.2
23	14	1.8	1.8	.6	.6	.6
23	15	5.4	5.4	5.4	5.4	0
23	16	1.9	1.9	1.9	1.9	0
23	17	1.2	1.2	1.2	1.2	0
23	18	3.8	3.8	3.8	3.8	0
23	19	3.8	3.8	0	0	0
23	20	4.5	4.5	0	0	0
23	21	13.1	13.1	0	0	0
23	22	0	0	0	0	0
23	23	8.9	8.9	0	0	0
23	24	8.6	8.6	0	0	0
23	25	0	0	0	0	0
23	26	0	0	0	0	0
23	27	0	0	0	0	0
23	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
24	1	0	0	0	0	0
24	2	0	0	0	0	0
24	3	1.8	0	0	0	0
24	4	4.1	4.1	.4	.4	0
24	5	5.1	5.1	2.3	2.3	0
24	6	5.0	5.0	3.2	3.2	0
24	7	5.0	5.0	2.5	2.5	0
24	8	7.9	7.9	2.9	2.9	0
24	9	8.2	8.2	2.5	2.5	0
24	10	1.5	1.5	0	0	0
24	11	8.9	8.9	0	0	0
24	12	10.4	10.4	2.8	0	0
24	13	1.2	1.2	2.8	2.8	2.8
24	14	1.2	1.2	1.2	1.2	1.2
24	15	2.8	2.8	2.8	2.8	2.8
24	16	2.8	2.8	2.3	2.3	2.3
24	17	2.3	2.3	2.3	2.3	2.3
24	18	0	0	6.1	6.1	6.1
24	19	0	0	0	0	0
24	20	8.9	8.9	.4	.4	0
24	21	12.7	12.7	.7	.7	0
24	22	0	0	0	0	0
24	23	11.5	11.5	0	0	0
24	24	9.6	9.6	0	0	0
24	25	0	0	0	0	0
24	26	0	0	.6	.6	0
24	27	0	0	.3	.3	0
24	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
25	1	0	0	0	0	0
25	2	0	0	0	0	0
25	3	0	0	0	0	0
25	4	0	0	0	0	0
25	5	.4	.4	.4	.4	0
25	6	2.2	2.2	2.2	2.2	0
25	7	6.0	6.0	6.0	6.0	0
25	8	2.6	2.6	2.6	1.3	0
25	9	1.5	1.5	1.5	1.3	0
25	10	0	0	0	0	0
25	11	0	0	0	0	0
25	12	0	0	0	0	0
25	13	1.2	1.2	1.2	1.2	1.2
25	14	1.0	1.0	1.0	1.0	1.0
25	15	1.6	1.6	1.6	.9	.9
25	16	1.8	1.8	1.8	.9	0
25	17	.3	.3	.3	.3	.3
25	18	1.8	1.8	1.8	0	0
25	19	.6	.6	.6	0	0
25	20	6.0	6.0	6.0	6.0	0
25	21	7.9	7.9	7.9	7.3	4.7
25	22	5.0	5.0	5.0	3.6	2.3
25	23	0	0	0	0	0
25	24	2.0	2.0	2.0	0	0
25	25	0	0	0	0	0
25	26	1.0	.3	.3	.3	.3
25	27	0	0	0	0	0
25	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
26	1	.6	.6	.6	.6	.6
26	2	7.4	7.4	7.4	7.4	7.4
26	3	1.5	1.5	1.5	1.5	1.5
26	4	2.0	2.0	2.0	2.0	2.0
26	5	0	0	0	0	0
26	6	0	0	0	0	0
26	7	0	0	0	0	0
26	8	0	0	0	0	0
26	9	0	0	0	0	0
26	10	0	0	0	0	0
26	11	0	0	0	0	0
26	12	0	0	0	0	0
26	13	1.1	1.1	1.1	1.1	1.1
26	14	6.0	6.0	6.0	0	0
26	15	4.1	4.1	4.1	0	0
26	16	7.1	7.1	7.1	2.0	0
26	17	4.7	4.7	4.7	0	0
26	18	13.4	13.4	13.4	0	0
26	19	7.1	7.1	0	0	0
26	20	5.8	5.8	5.8	5.8	5.8
26	21	11.2	11.2	11.2	11.2	11.2
26	22	14.3	14.3	14.3	14.3	14.3
26	23	2.9	2.9	2.9	2.9	2.9
26	24	6.2	6.2	6.2	6.2	6.2
26	25	0	0	0	0	0
26	26	0	0	0	0	0
26	27	0	0	0	0	0
26	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
27	1	.3	.3	.3	.3	.3
27	2	1.0	1.0	.3	1.0	1.0
27	3	.6	.6	1.0	.6	.6
27	4	1.9	1.9	1.9	1.9	1.9
27	5	0	0	0	0	0
27	6	0	0	0	0	0
27	7	0	0	0	0	0
27	8	0	0	0	0	0
27	9	0	0	0	0	0
27	10	0	0	0	0	0
27	11	0	0	0	0	0
27	12	0	0	0	0	0
27	13	.6	.6	.6	.6	.6
27	14	12.1	12.1	12.1	1.6	1.2
27	15	2.6	2.6	2.6	.4	.4
27	16	5.5	5.5	5.5	0	0
27	17	.9	.9	.9	.4	0
27	18	8.5	8.5	.3	.3	0
27	19	51.1	51.0	0	0	0
27	20	5.6	5.6	7.4	7.4	3.5
27	21	3.5	3.5	3.5	3.5	1.9
27	22	11.8	11.8	11.8	11.8	11.8
27	23	0	0	0	0	0
27	24	0	0	0	0	0
27	25	2.8	2.8	0	0	0
27	26	0	0	0	0	0
27	27	0	0	0	0	0
27	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
28	1	5.4	5.4	5.4	5.4	5.4
28	2	13.1	13.1	13.1	13.1	13.1
28	3	6.2	6.2	6.2	6.2	6.2
28	4	1.3	1.3	1.3	1.3	1.3
28	5	5.0	5.0	5.0	5.0	5.0
28	6	1.8	1.8	1.8	1.8	1.8
28	7	1.8	1.8	1.8	1.8	1.8
28	8	1.0	1.0	1.0	1.0	1.0
28	9	0	0	0	0	0
28	10	0	0	0	0	0
28	11	.4	.4	.4	.4	.4
28	12	.7	.7	.7	.7	.7
28	13	.4	.4	.4	.4	.4
28	14	2.0	2.0	2.0	2.0	2.0
28	15	2.5	2.5	2.5	2.5	2.5
28	16	1.3	1.3	1.3	1.3	1.3
28	17	.4	.4	.4	.4	.4
28	18	8.5	8.5	0	0	0
28	19	7.9	7.9	0	0	0
28	20	5.1	5.1	5.1	5.1	3.9
28	21	6.9	5.7	5.7	5.7	3.2
28	22	5.7	5.7	3.4	3.4	2.5
28	23	0	0	0	0	0
28	24	2.6	2.6	0	0	0
28	25	6.6	6.6	0	0	0
28	26	0	0	0	0	0
28	27	0	0	0	0	0
28	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
30	1	7.4	7.4	7.4	0	0
30	2	4.5	4.5	4.5	0	0
30	3	15.7	15.7	15.7	15.7	15.7
30	4	15.2	15.2	15.2	15.2	15.2
30	5	15.7	15.7	15.7	15.7	15.7
30	6	17.9	17.9	17.9	17.9	17.9
30	7	2.9	2.9	2.9	2.9	2.9
30	8	3.5	3.5	3.5	3.5	3.5
30	9	3.9	3.9	3.9	3.9	3.9
30	10	.9	.9	.9	.9	.9
30	11	0	0	0	0	0
30	12	.4	.4	.4	.4	.4
30	13	.6	.6	.6	.6	.6
30	14	.6	.6	.6	.6	.6
30	15	.3	.3	.3	.3	.3
30	16	.6	.6	.6	.6	.6
30	17	.3	.3	.3	.3	.3
30	18	1.5	1.5	1.5	.3	.3
30	19	22.6	22.6	0	0	0
30	20	33.7	33.7	0	0	0
30	21	14.1	14.1	0	0	0
30	22	2.9	1.0	0	0	0
30	23	0	0	0	0	0
30	24	6.1	4.8	0	0	0
30	25	11.2	.1	0	0	0
30	26	.3	0	0	0	0
30	27	.7	0	0	0	0
30	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
31	1	0	0	0	0	0
31	2	20.4	20.4	0	0	0
31	3	20.4	20.4	20.4	20.4	20.4
31	4	17.8	17.8	17.8	17.8	17.8
31	5	9.5	9.5	9.5	9.5	9.5
31	6	17.8	17.8	17.8	17.8	17.8
31	7	9.9	9.9	9.9	9.9	9.9
31	8	17.4	17.4	17.4	17.4	17.4
31	9	12.0	12.0	12.0	12.0	12.0
31	10	.9	.9	.9	.9	.9
31	11	0	0	0	0	0
31	12	6.2	6.2	6.2	6.2	6.2
31	13	1.9	1.9	1.9	1.9	1.9
31	14	1.3	1.3	1.3	1.3	1.3
31	15	1.3	1.3	1.3	0	0
31	16	.7	.7	.7	0	0
31	17	.1	.1	.1	.1	.1
31	18	0	0	0	0	0
31	19	0	0	0	0	0
31	20	0	0	0	0	0
31	21	0	0	0	0	0
31	22	0	0	0	0	0
31	23	1.3	1.3	1.3	1.3	1.3
31	24	0	0	11.6	11.6	11.6
31	25	0	0	11.6	11.6	11.6
31	26	0	0	0	0	0
31	27	0	0	0	0	0
31	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
32	1	0	0	0	0	0
32	2	6.2	6.2	6.2	0	0
32	3	17.1	17.1	17.1	17.1	17.1
32	4	17.7	17.7	17.7	17.7	17.7
32	5	18.8	18.8	18.8	18.8	18.8
32	6	20.3	20.3	20.3	20.3	20.3
32	7	12.0	12.0	12.0	12.0	12.0
32	8	7.1	7.1	7.1	7.1	7.1
32	9	3.6	3.6	3.6	3.6	3.6
32	10	0	0	0	0	0
32	11	.6	.6	.6	.6	.6
32	12	.9	.9	.9	.9	.9
32	13	17.7	17.7	17.7	17.7	17.7
32	14	8.9	8.9	8.9	8.9	8.9
32	15	7.0	7.0	6.2	.7	.7
32	16	3.6	3.6	3.6	.6	.6
32	17	1.3	1.3	1.3	0	0
32	18	.1	.1	.1	0	0
32	19	1.5	1.5	1.5	1.5	1.5
32	20	.6	.6	.6	.6	.6
32	21	0	0	0	0	0
32	22	0	0	0	0	0
32	23	0	0	0	0	0
32	24	0	0	5.9	5.9	5.9
32	25	0	0	11.6	11.6	11.6
32	26	0	0	0	0	11.6
32	27	0	0	0	0	0
32	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
33	1	1.3	1.3	1.3	0	0
33	2	13.4	13.4	13.4	0	0
33	3	14.6	14.6	14.6	0	0
33	4	22.8	22.8	22.8	22.8	22.8
33	5	18.8	18.8	18.8	18.8	18.8
33	6	16.6	16.6	16.6	16.6	16.6
33	7	.6	.6	.6	.6	.6
33	8	1.3	1.3	1.3	1.3	1.3
33	9	3.8	3.8	3.8	3.8	3.8
33	10	1.3	1.3	1.3	1.3	1.3
33	11	8.5	8.5	8.5	8.5	8.5
33	12	14.6	14.6	14.6	14.6	14.6
33	13	5.7	5.7	5.7	5.7	5.7
33	14	29.8	29.8	29.8	29.8	29.8
33	15	1.0	1.0	1.0	1.0	1.0
33	16	8.8	8.8	8.8	.1	.1
33	17	0	0	0	0	0
33	18	1.3	1.3	1.3	1.3	1.3
33	19	12.0	12.0	12.0	12.0	12.0
33	20	2.2	2.2	2.2	2.2	2.2
33	21	1.3	1.3	1.3	0	0
33	22	0	0	0	0	0
33	23	0	0	11.6	11.6	11.6
33	24	0	0	0	0	0
33	25	0	0	11.6	11.6	11.6
33	26	0	0	0	0	0
33	27	43.3	0	0	0	0
33	28	34.7	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
34	1	2.3	2.3	2.3	0	0
34	2	11.2	11.2	11.2	0	0
34	3	8.9	8.9	8.9	0	0
34	4	12.7	12.7	12.7	.9	0
34	5	16.3	16.3	16.3	16.3	16.3
34	6	17.8	17.8	17.8	17.8	17.8
34	7	8.9	8.9	8.9	8.9	8.9
34	8	7.4	7.4	7.4	7.4	7.4
34	9	1.3	1.3	1.3	1.3	1.3
34	10	3.8	3.8	3.8	3.8	3.8
34	11	12.0	12.0	12.0	12.0	12.0
34	12	21.9	21.9	21.9	21.9	21.9
34	13	6.0	6.0	6.0	0	0
34	14					
34	15					
34	16					
34	17					
34	18					
34	19					
34	20					
34	21					
34	22	11.4	11.4	11.4	0	0
34	23	8.8	8.8	8.8	11.6	11.6
34	24	0	0	0	0	0
34	25	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
35	1	3.1	3.1	3.1	.6	.6
35	2	10.4	10.4	10.4	.3	.3
35	3	12.7	12.7	12.7	0	0
35	4	12.4	12.4	12.4	0	0
35	5	16.6	16.6	16.6	0	0
35	6	11.2	11.2	11.2	11.2	11.2
35	7	12.7	12.7	12.7	12.7	12.7
35	8	9.6	9.6	9.6	9.6	9.6
35	9	7.9	7.9	7.9	7.9	7.9
35	10	17.7	17.7	17.7	17.7	17.7
35	11	8.9	8.9	8.9	8.9	8.9
35	12	6.0	6.0	6.0	6.0	6.0
35	13					
35	14					
35	15					
35	16					
35	17					
35	18					
35	19					
35	20					
35	21					
35	22					
35	23					
35	24	8.5	8.5	8.5	0	0
35	25	7.1	7.1	7.1	0	0
35	26	0	0	0	0	0
35	27	0	0	0	0	0
35	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
36	1	.6	.6	.6	0	0
36	2	6.0	6.0	6.0	0	0
36	3	16.3	16.3	16.3	0	0
36	4	13.4	13.4	13.4	0	0
36	5	16.3	16.3	16.3	0	0
36	6	.6	.6	.6	0	0
36	7					
36	8					
36	9					
36	10					
36	11					
36	12					
36	13					
36	14					
36	15					
36	16					
36	17					
36	18					
36	19					
36	20					
36	21					
36	22					
36	23					
36	24					
36	25					
36	26	11.4	11.4	11.4	0	0
36	27	7.4	7.4	7.4	0	0
36	28	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
37	1	0	0	0	0	0
37	2	4.7	4.7	4.7	.6	0
37	3					
37	4					
37	5					
37	6					
37	7					
37	8					
37	9					
37	10					
37	11					
37	12					
37	13					
37	14					
37	15					
37	16					
37	17					
37	18					
37	19					
37	20					
37	21					
37	22					
37	23					
37	24					
37	25					
37	26					
37	27					
37	28	6.2	6.2	6.2	0	0

Col.	Row	1972	1965	1958	1950	1943
38	1	0	0	0	0	0
38	2					
38	3					
38	4					
38	5					
38	6					
38	7					
38	8					
38	9					
38	10					
38	11					
38	12					
38	13					
38	14					
38	15					
38	16					
38	17					
38	18					
38	19					
38	20					
38	21					
38	22					
38	23					
38	24					
38	25					
38	26					
38	27					
38	28	0	0	0	0	0

Part 2. Southwest Subarea - Recharge in gal/min.

Node Point Col.	Row	1972	1965	1958	1950	1943
1	1	0	0	0	0	0
1	2	0	0	0	0	0
1	3	0	0	0	0	0
1	4	0	0	0	0	0
1	5	0	0	0	0	0
1	6	0	0	0	0	0
1	7	0	0	0	0	0
1	8	0	0	0	0	0
1	9	0	0	0	0	0
1	10	0	0	0	0	0
1	11	0	0	0	0	0
1	12	0	0	0	0	0
1	13	0	0	0	0	0
1	14	0	0	0	0	0
1	15	0	0	0	0	0
1	16	0	0	0	0	0
1	17	0	0	0	0	0
1	18	0	0	0	0	0
1	19	0	0	0	0	0
1	20	0	0	0	0	0
1	21	0	0	0	0	0
1	22	0	0	0	0	0
1	23	0	0	0	0	0
1	24	0	0	0	0	0
1	25	0	0	0	0	0
1	26	0	0	0	0	0
1	27	0	0	0	0	0
1	28	0	0	0	0	0
1	29	0	0	0	0	0
1	30	0	0	0	0	0
1	31	0	0	0	0	0
1	32	0	0	0	0	0
1	33	0	0	0	0	0
1	34	0	0	0	0	0
1	35	0	0	0	0	0
1	36	0	0	0	0	0
1	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
2	1	0	0	0	0	0
2	2	1.0	1.0	1.0	0	0
2	3	0	0	0	0	0
2	4	0	0	0	0	0
2	5	0	0	0	0	0
2	6	0	0	0	0	0
2	7	0	0	0	0	0
2	8	0	0	0	0	0
2	9	0	0	0	0	0
2	10	1.3	1.0	0	0	0
2	11	.4	.4	0	0	0
2	12	0	0	0	0	0
2	13	0	0	0	0	0
2	14	0	0	0	0	0
2	15	0	0	0	0	0
2	16	0	0	0	0	0
2	17	0	0	0	0	0
2	18	0	0	0	0	0
2	19	0	0	0	0	0
2	20	0	0	0	0	0
2	21	0	0	0	0	0
2	22	0	0	0	0	0
2	23	0	0	0	0	0
2	24	0	0	0	0	0
2	25	0	0	0	0	0
2	26	0	0	0	0	0
2	27	0	0	0	0	0
2	28	0	0	0	0	0
2	29	0	0	0	0	0
2	30	0	0	0	0	0
2	31	0	0	0	0	0
2	32	0	0	0	0	0
2	33	0	0	0	0	0
2	34	0	0	0	0	0
2	35	8.9	8.9	0	0	0
2	36	17.1	17.1	0	0	0
2	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
3	1	0	0	0	0	0
3	2	0	0	0	0	0
3	3	0	0	0	0	0
3	4	0	0	0	0	0
3	5	0	0	0	0	0
3	6	0	0	0	0	0
3	7	0	0	0	0	0
3	8	0	0	0	0	0
3	9	0	0	0	0	0
3	10	0	0	0	0	0
3	11	0	0	0	0	0
3	12	0	0	0	0	0
3	13	0	0	0	0	0
3	14	0	0	0	0	0
3	15	0	0	0	0	0
3	16	0	0	0	0	0
3	17	0	0	0	0	0
3	18	0	0	0	0	0
3	19	0	0	0	0	0
3	20	0	0	0	0	0
3	21	0	0	0	0	0
3	22	19.6	19.6	0	0	0
3	23	20.0	20.0	0	0	0
3	24	16.0	16.0	0	0	0
3	25	18.0	18.0	0	0	0
3	26	10.0	10.0	0	0	0
3	27	0	0	0	0	0
3	28	0	0	0	0	0
3	29	0	0	0	0	0
3	30	0	0	0	0	0
3	31	0	0	0	0	0
3	32	.6	.6	.6	.6	0
3	33	0	0	0	0	0
3	34	0	0	0	0	0
3	35	14.6	8.9	0	0	0
3	36	0	0	0	0	0
3	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
4	1	0	0	0	0	0
4	2	.4	.4	0	0	0
4	3	1.2	.3	0	0	0
4	4	0	0	0	0	0
4	5	0	0	0	0	0
4	6	.3	0	0	0	0
4	7	0	0	0	0	0
4	8	0	0	0	0	0
4	9	0	0	0	0	0
4	10	0	0	0	0	0
4	11	.3	.3	.3	0	0
4	12	0	0	0	0	0
4	13	0	0	0	0	0
4	14	0	0	0	0	0
4	15	0	0	0	0	0
4	16	0	0	0	0	0
4	17	0	0	0	0	0
4	18	12.4	12.4	0	0	0
4	19	1.3	0	0	0	0
4	20	0	0	0	0	0
4	21	7.4	7.4	0	0	0
4	22	30.0	30.0	0	0	0
4	23	38.8	38.8	0	0	0
4	24	28.0	28.0	0	0	0
4	25	24.0	24.0	0	0	0
4	26	11.2	11.2	0	0	0
4	27	0	0	0	0	0
4	28	2.5	2.5	2.5	0	0
4	29	1.3	1.3	0	0	0
4	30	5.0	5.0	5.0	0	0
4	31	.3	.3	.3	0	0
4	32	0	0	0	0	0
4	33	0	0	0	0	0
4	34	0	0	0	0	0
4	35	0	0	0	0	0
4	36	.4	0	0	0	0
4	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
5	1	0	0	0	0	0
5	2	0	0	0	.2	0
5	3	0	0	0	0	0
5	4	0	0	0	0	0
5	5	0	0	0	.2	0
5	6	0	0	0	0	0
5	7	0	0	0	0	0
5	8	0	0	0	0	0
5	9	0	0	0	0	0
5	10	0	0	0	0	0
5	11	.6	.6	.6	0	0
5	12	0	0	0	0	0
5	13	0	0	0	0	0
5	14	.6	.6	.6	0	0
5	15	.6	.6	.6	.6	.3
5	16	.4	.4	.4	.4	.4
5	17	0	0	0	0	0
5	18	5.0	0	0	0	0
5	19	0	0	0	.3	.3
5	20	2.5	2.5	2.5	.3	.3
5	21	5.0	5.0	5.0	0	0
5	22	2.5	2.5	2.5	2.5	1.8
5	23	.6	.6	.6	.6	.6
5	24	.1	.1	.1	.1	.1
5	25	12.4	12.4	0	0	0
5	26	1.3	1.3	0	0	0
5	27	1.3	1.3	1.3	1.3	.6
5	28	.1	.1	.1	.1	.1
5	29	.1	.1	.1	.1	.1
5	30	.4	.4	0	0	0
5	31	5.0	5.0	0	0	0
5	32	1.3	1.3	0	0	0
5	33	0	0	0	0	0
5	34	0	0	0	0	0
5	35	.1	0	0	0	0
5	36	0	0	0	0	0
5	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
6	1	0	0	0	0	0
6	2	1.3	1.3	.6	0	0
6	3	0	0	0	0	0
6	4	0	0	0	0	0
6	5	0	0	0	0	0
6	6	.1	.1	.1	0	0
6	7	.6	.6	.3	0	0
6	8	.3	.3	.3	0	0
6	9	0	0	0	0	0
6	10	0	0	0	0	0
6	11	0	0	0	0	0
6	12	0	0	0	0	0
6	13	5.0	5.0	5.0	0	0
6	14	.3	.3	.3	.3	.3
6	15	0	0	0	0	0
6	16	0	0	0	0	0
6	17	3.1	3.1	2.8	2.8	1.2
6	18	.9	.9	.5	0	0
6	19	1.2	1.2	.5	0	0
6	20	6.3	6.3	6.3	0	0
6	21	7.4	7.4	7.4	0	0
6	22	24.0	24.0	0	0	0
6	23	20.0	20.0	0	0	0
6	24	6.0	6.0	0	0	0
6	25	12.0	12.0	0	0	0
6	26	0	0	0	0	0
6	27	21.8	21.8	21.8	0	0
6	28	3.1	3.1	3.1	3.1	0
6	29	9.3	9.3	9.3	9.3	0
6	30	0	0	0	0	0
6	31	11.2	11.2	11.2	11.2	3.1
6	32	15.5	15.5	15.5	15.5	7.9
6	33	0	0	0	0	0
6	34	.1	0	0	0	0
6	35	0	0	0	0	0
6	36	0	0	0	0	0
6	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
7	1	0	0	0	0	0
7	2	.4	.4	.3	0	0
7	3	1.6	1.6	.6	0	0
7	4	1.6	1.6	.6	0	0
7	5	0	0	0	0	0
7	6	0	0	0	0	0
7	7	0	0	0	0	0
7	8	0	0	0	0	0
7	9	0	0	0	0	0
7	10	0	0	0	0	0
7	11	0	0	0	0	0
7	12	0	0	0	0	0
7	13	0	0	0	0	0
7	14	0	0	0	0	0
7	15	0	0	0	0	0
7	16	0	0	0	0	0
7	17	0	0	0	0	0
7	18	0	0	0	0	0
7	19	2.3	0	0	0	0
7	20	.3	0	0	0	0
7	21	6.3	6.3	0	0	0
7	22	36.0	36.0	0	0	0
7	23	40.0	10.0	0	0	0
7	24	18.0	5.8	0	0	0
7	25	0	0	0	0	0
7	26	0	0	0	0	0
7	27	.3	0	0	0	0
7	28	1.3	1.3	0	0	0
7	29	12.4	12.4	12.4	12.4	0
7	30	.1	.1	.1	.1	0
7	31	1.3	1.3	1.3	1.3	1.3
7	32	9.3	9.3	9.3	9.3	9.3
7	33	2.6	.3	.3	.3	.3
7	34	.1	0	0	0	0
7	35	0	0	0	0	0
7	36	0	0	0	0	0
7	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
8	1	0	0	0	0	0
8	2	1.3	0	0	0	0
8	3	0	0	0	0	0
8	4	0	0	0	0	0
8	5	0	0	0	0	0
8	6	.6	.6	.2	0	0
8	7	.3	0	0	0	0
8	8	0	0	0	0	0
8	9	0	0	0	0	0
8	10	0	0	0	0	0
8	11	0	0	0	0	0
8	12	0	0	0	0	0
8	13	0	0	0	0	0
8	14	0	0	0	0	0
8	15	0	0	0	0	0
	16	0	0	0	0	0
8	17	0	0	0	0	0
8	18	0	0	0	0	0
8	19	1.5	1.5	.6	0	0
8	20	0	0	0	0	0
8	21	0	0	0	0	0
8	22	6.4	6.4	0	0	0
8	23	10.0	10.0	0	0	0
8	24	5.8	5.8	0	0	0
8	25	1.3	1.3	0	0	0
8	26	0	0	0	0	0
8	27	0	0	0	0	0
8	28	6.3	3.1	3.1	3.1	0
8	29	12.0	12.0	12.0	12.0	0
8	30	30.0	30.0	30.0	30.0	0
8	31	30.0	30.0	30.0	30.0	0
8	32	9.0	5.0	5.0	5.0	0
8	33	.3	.3	.3	.3	0
8	34	5.0	0	0	0	0
8	35	0	0	0	0	0
8	36	0	0	0	0	0
8	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
9	1	0	0	0	0	0
9	2	.3	.3	.1	0	0
9	3	.4	0	0	0	0
9	4	37.2	0	0	0	0
9	5	93.1	0	0	0	0
9	6	0	0	0	0	0
9	7	0	0	0	0	0
9	8	.4	0	0	0	0
9	9	0	0	0	0	0
9	10	0	0	0	0	0
9	11	0	0	0	0	0
9	12	0	0	0	0	0
9	13	0	0	0	0	0
9	14	0	0	0	0	0
9	15	0	0	0	0	0
9	16	0	0	0	0	0
9	17	0	0	0	0	0
9	18	0	0	0	0	0
9	19	0	0	0	0	0
9	20	0	0	0	0	0
9	21	1.3	1.3	0	0	0
9	22	2.5	1.0	0	0	0
9	23	0	0	0	0	0
9	24	2.9	2.9	0	0	0
9	25	3.9	3.9	0	0	0
9	26	1.9	1.9	0	0	0
9	27	0	0	0	0	0
9	28	5.0	5.0	5.0	5.0	0
9	29	4.0	4.0	4.0	4.0	0
9	30	30.0	30.0	30.0	30.0	0
9	31	30.0	30.0	30.0	30.0	0
9	32	9.3	9.3	9.3	9.3	0
9	33	1.3	1.3	1.3	1.3	0
9	34	.1	.1	.1	.1	0
9	35	6.3	6.3	6.3	6.3	0
9	36	0	0	0	0	0
9	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
10	1	0	0	0	0	0
10	2	.4	.4	.3	0	0
10	3	.6	0	0	0	0
10	4	18.0	0	0	0	0
10	5	36.0	0	0	0	0
10	6	0	0	0	0	0
10	7	0	0	0	0	0
10	8	0	0	0	0	0
10	9	0	0	0	0	0
10	10	0	0	0	0	0
10	11	0	0	0	0	0
10	12	0	0	0	0	0
10	13	0	0	0	0	0
10	14	0	0	0	0	0
10	15	0	0	0	0	0
10	16	0	0	0	0	0
10	17	0	0	0	0	0
10	18	0	0	0	0	0
10	19	0	0	0	0	0
10	20	0	0	0	0	0
10	21	1.3	1.3	0	0	0
10	22	2.5	2.5	.3	.3	.3
10	23	0	0	0	0	0
10	24	0	0	0	0	0
10	25	0	0	0	0	0
10	26	.1	.1	.1	.1	.1
10	27	0	0	0	0	0
10	28	0	0	0	0	0
10	29	6.0	6.0	6.0	6.0	0
10	30	16.0	16.0	16.0	16.0	0
10	31	24.0	24.0	24.0	24.0	0
10	32	6.0	6.0	6.0	6.0	0
10	33	.1	.1	0	0	0
10	34	0	0	0	0	0
10	35	0	0	0	0	0
10	36	0	0	0	0	0
10	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
11	1	0	0	0	0	0
11	2	.3	.3	.3	0	0
11	3	6.0	6.0	0	0	0
11	4	0	0	0	0	0
11	5	0	0	0	0	0
11	6	6.0	6.0	0	0	0
11	7	8.0	8.0	0	0	0
11	8	.1	.1	0	0	0
11	9	0	0	0	0	0
11	10	0	0	0	0	0
11	11	0	0	0	0	0
11	12	0	0	0	0	0
11	13	0	0	0	0	0
11	14	0	0	0	0	0
11	15	0	0	0	0	0
11	16	0	0	0	0	0
11	17	0	0	0	0	0
11	18	0	0	0	.3	.3
11	19	0	0	0	0	0
11	20	0	0	0	0	0
11	21	0	0	0	0	0
11	22	0	0	0	0	0
11	23	1.3	1.3	1.3	0	0
11	24	0	0	0	0	0
11	25	2.6	2.6	0	0	0
11	26	0	0	0	0	0
11	27	6.3	6.3	6.3	0	0
11	28	12.4	12.4	12.4	0	0
11	29	.4	.4	.4	.4	0
11	30	.3	.3	.3	.3	0
11	31	1.3	1.3	1.3	1.3	0
11	32	2.6	2.6	2.6	0	0
11	33	5.0	5.0	0	0	0
11	34	1.9	1.9	0	0	0
11	35	8.0	8.0	0	0	0
11	36	0	0	0	0	0
11	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
12	1	0	0	0	0	0
12	2	0	0	0	0	0
12	3	.6	.6	0	0	0
12	4	0	0	0	0	0
12	5	0	0	0	0	0
12	6	0	0	0	0	0
12	7	.6	.6	.3	.3	.3
12	8	.3	.3	.3	.3	.3
12	9	1.5	.6	0	0	0
12	10	0	0	0	0	0
12	11	1.9	1.9	0	0	0
12	12	0	0	0	0	0
12	13	0	0	0	0	0
12	14	0	0	0	.1	.1
12	15	0	0	0	.1	.1
12	16	0	0	0	.1	.1
12	17	2.2	2.2	1.5	1.1	0
12	18	0	0	0	0	0
12	19	0	0	0	0	0
12	20	1.2	1.2	.6	0	0
12	21	.6	.6	.6	.6	.3
12	22	0	0	0	0	0
12	23	0	0	0	0	0
12	24	0	0	0	.1	.1
12	25	0	0	0	0	0
12	26	0	0	0	0	0
12	27	0	0	0	0	0
12	28	1.9	1.9	1.9	0	0
12	29	.9	.9	.9	.3	.3
12	30	.3	.3	.3	0	0
12	31	0	0	0	0	0
12	32	0	0	0	0	0
12	33	.3	0	0	0	0
12	34	14.0	14.0	0	0	0
12	35	12.0	12.0	0	0	0
12	36	0	0	0	0	0
12	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
13	1	0	0	0	0	0
13	2	0	0	0	0	0
13	3	0	0	0	.6	.6
13	4	0	0	0	0	0
13	5	0	0	0	0	0
13	6	1.3	1.3	.4	.4	.4
13	7	0	0	0	0	0
13	8	1.9	1.9	1.9	1.9	1.9
13	9	12.8	12.8	0	0	0
13	10	2.6	2.6	0	0	0
13	11	0	0	0	0	0
13	12	0	0	0	0	0
13	13	0	0	0	0	0
13	14	1.5	1.5	1.2	.6	.6
13	15	2.5	2.5	2.5	2.5	2.5
13	16	2.9	2.9	2.0	1.2	.9
13	17	.7	.4	.4	.4	.4
13	18	3.9	3.9	.4	.4	.4
13	19	4.8	4.8	3.8	2.5	0
13	20	3.2	3.2	2.3	.4	0
13	21	.6	.6	.6	.6	0
13	22	0	0	0	0	0
13	23	.1	0	0	0	0
13	24	.7	.7	0	0	0
13	25	0	0	0	0	0
13	26	0	0	0	0	0
13	27	0	0	0	0	0
13	28	3.2	3.2	0	0	0
13	29	0	0	0	0	0
13	30	0	0	0	0	0
13	31	0	0	0	0	0
13	32	18.7	18.7	.6	.6	0
13	33	26.0	26.0	.4	.4	0
13	34	28.0	28.0	.2	.2	0
13	35	16.0	16.0	.2	.2	0
13	36	0	0	0	0	0
13	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
14	1	0	0	0	0	0
14	2	0	0	0	0	0
14	3	0	0	0	0	0
14	4	0	0	0	0	0
14	5	0	0	0	0	0
14	6	.9	.3	0	0	0
14	7	0	0	0	0	0
14	8	0	0	0	0	0
14	9	0	0	0	0	0
14	10	0	0	0	0	0
14	11	.3	.3	.3	.3	.3
14	12	0	0	0	0	0
14	13	0	0	0	0	0
14	14	3.6	.3	.3	.3	.3
14	15	1.0	1.0	0	0	0
14	16	0	0	0	0	0
14	17	1.2	1.2	0	0	0
14	18	15.6	15.6	0	0	0
14	19	6.0	6.0	0	0	0
14	20	14.6	14.6	14.6	0	0
14	21	6.3	6.3	6.3	0	0
14	22	0	0	0	0	0
14	23	0	0	0	0	0
14	24	12.4	12.4	0	0	0
14	25	9.9	9.9	0	0	0
14	26	0	0	0	0	0
14	27	0	0	0	0	0
14	28	0	0	0	0	0
14	29	0	0	0	0	0
14	30	0	0	0	0	0
14	31	0	0	0	0	0
14	32	8.0	8.0	0	0	0
14	33	26.0	26.0	0	0	0
14	34	16.0	16.0	0	0	0
14	35	18.0	18.0	0	0	0
14	36	0	0	0	0	0
14	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
15	1	0	0	0	0	0
15	2	.7	.7	.7	.7	.7
15	3	0	0	0	0	0
15	4	0	0	0	0	0
15	5	.3	0	0	0	0
15	6	0	0	0	0	0
15	7	0	0	0	0	0
15	8	0	0	0	0	0
15	9	.4	.4	.3	.3	.1
15	10	0	0	0	0	0
15	11	0	0	0	0	0
15	12	0	0	0	0	0
15	13	0	0	0	0	0
15	14	0	0	0	0	0
15	15	7.7	5.8	.4	.4	.4
15	16	4.1	.6	0	0	0
15	17	13.4	13.4	0	0	0
15	18	17.1	17.1	0	0	0
15	19	1.5	1.5	0	0	0
15	20	13.9	13.9	13.9	0	0
15	21	0	0	0	0	0
15	22	0	0	0	0	0
15	23	15.5	15.5	0	0	0
15	24	31.1	31.1	0	0	0
15	25	9.9	9.9	0	0	0
15	26	0	0	0	0	0
15	27	0	0	0	0	0
15	28	0	0	0	0	0
15	29	0	0	0	0	0
15	30	3.8	3.8	0	0	0
15	31	5.0	5.0	0	0	0
15	32	6.4	6.4	0	0	0
15	33	12.0	12.0	0	0	0
15	34	8.0	8.0	0	0	0
15	35	20.0	18.0	0	0	0
15	36	0	0	0	0	0
15	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
16	1	0	0	0	0	0
16	2	0	0	0	0	0
16	3	1.3	1.3	1.3	1.3	1.3
16	4	.4	0	0	0	0
16	5	0	0	0	0	0
16	6	0	0	0	0	0
16	7	1.3	1.3	.9	.9	.9
16	8	0	0	0	0	0
16	9	0	0	0	0	0
16	10	2.2	2.2	2.2	2.2	2.2
16	11	1.3	1.3	1.3	1.3	1.3
16	12	0	0	0	0	0
16	13	0	0	0	0	0
16	14	1.0	1.0	.4	.4	.4
16	15	.3	.3	.3	.3	.3
16	16	.3	.3	.3	.3	.3
16	17	6.4	2.6	.4	.4	.4
16	18	7.4	0	0	0	0
16	19	1.5	0	0	0	0
16	20	3.9	3.9	3.9	.9	0
16	21	1.5	1.5	1.5	1.5	0
16	22	.1	.1	.1	.1	0
16	23	2.5	2.5	2.5	1.3	0
16	24	0	0	0	0	0
16	25	1.3	0	0	0	0
16	26	1.3	1.3	0	0	0
16	27	0	0	0	0	0
16	28	0	0	0	0	0
16	29	0	0	0	0	0
16	30	0	0	0	0	0
16	31	0	0	0	0	0
16	32	6.7	6.7	0	0	0
16	33	.6	.6	0	0	0
16	34	0	0	0	0	0
16	35	1.9	1.9	0	0	0
16	36	0	0	0	0	0
16	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
17	1	0	0	0	0	0
17	2	0	0	0	0	0
17	3	0	0	0	0	0
17	4	1.3	1.3	1.3	1.3	0
17	5	0	0	0	0	0
17	6	0	0	0	0	0
17	7	0	0	0	0	0
17	8	0	0	0	0	0
17	9	5.7	4.7	2.3	0	0
17	10	3.6	1.0	.4	0	0
17	11	.6	.6	.5	.5	0
17	12	0	0	0	0	0
17	13	0	0	0	0	0
17	14	0	0	0	0	0
17	15	.3	.3	0	0	0
17	16	1.5	1.5	0	0	0
17	17	2.5	2.5	1.2	0	0
17	18	0	0	0	0	0
17	19	0	0	0	0	0
17	20	1.9	1.9	1.2	.4	0
17	21	0	0	0	0	0
17	22	.1	0	0	0	0
17	23	6.3	6.3	0	0	0
17	24	0	0	0	0	0
17	25	0	0	0	0	0
17	26	0	0	0	0	0
17	27	0	0	0	0	0
17	28	1.3	1.3	0	0	0
17	29	10.9	10.9	0	0	0
17	30	7.4	7.4	0	0	0
17	31	17.1	17.1	0	0	0
17	32	19.4	19.4	0	0	0
17	33	14.9	14.9	0	0	0
17	34	18.4	18.4	0	0	0
17	35	17.8	17.8	0	0	0
17	36	0	0	0	0	0
17	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
18	1	0	0	0	0	0
18	2	0	0	0	0	0
18	3	0	0	0	0	0
18	4	0	0	0	0	0
18	5	0	0	0	0	0
18	6	0	0	0	0	0
18	7	0	0	0	0	0
18	8	0	0	0	0	0
18	9	4.1	4.1	2.1	1.1	0
18	10	1.0	0	0	0	0
18	11	.4	0	0	0	0
18	12	0	0	0	0	0
18	13	0	0	0	0	0
18	14	.3	.3	0	0	0
18	15	1.2	.3	0	0	0
18	16	1.2	1.2	.6	0	0
18	17	1.0	1.0	.4	0	0
18	18	0	0	0	0	0
18	19	0	0	0	0	0
18	20	1.2	1.1	.6	0	0
18	21	0	0	0	0	0
18	22	0	0	0	0	0
18	23	18.7	6.6	0	0	0
18	24	.3	.3	0	0	0
18	25	0	0	0	0	0
18	26	0	0	0	0	0
18	27	1.0	1.0	0	0	0
18	28	12.4	12.4	0	0	0
18	29	40.6	40.6	0	0	0
18	30	8.3	8.3	0	0	0
18	31	11.2	11.2	0	0	0
18	32	10.7	10.7	0	0	0
18	33	12.0	12.0	0	0	0
18	34	15.6	15.6	0	0	0
18	35	20.6	20.6	0	0	0
18	36	0	0	0	0	0
18	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
19	1	0	0	0	0	0
19	2	0	0	0	0	0
19	3	.3	.3	0	0	0
19	4	0	0	0	0	0
19	5	.3	0	0	0	0
19	6	0	0	0	0	0
19	7	0	0	0	0	0
19	8	1.3	0	0	0	0
19	9	3.2	2.5	1.2	.4	0
19	10	1.3	1.3	1.0	1.0	0
19	11	.6	.6	0	0	0
19	12	0	0	0	0	0
19	13	0	0	0	0	0
19	14	1.6	1.6	0	0	0
19	15	1.8	0	0	0	0
19	16	0	0	0	0	0
19	17	0	0	0	0	0
19	18	0	0	0	0	0
19	19	10.5	10.5	0	0	0
19	20	3.5	3.5	0	0	0
19	21	1.5	1.5	0	0	0
19	22	0	0	0	0	0
19	23	23.4	13.5	0	0	0
19	24	0	0	0	0	0
19	25	5.7	5.7	0	0	0
19	26	.1	.1	0	0	0
19	27	0	0	0	0	0
19	28	16.0	16.0	0	0	0
19	29	30.0	30.0	0	0	0
19	30	24.0	24.0	0	0	0
19	31	24.0	24.0	0	0	0
19	32	10.7	10.7	0	0	0
19	33	17.8	17.8	0	0	0
19	34	17.8	17.8	0	0	0
19	35	17.8	17.8	0	0	0
19	36	0	0	0	0	0
19	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
20	1	0	0	0	0	0
20	2	2.8	0	0	0	0
20	3	0	0	0	0	0
20	4	0	0	0	0	0
20	5	0	0	0	0	0
20	6	1.8	1.8	.9	.9	0
20	7	0	0	0	0	0
20	8	.3	0	0	0	0
20	9	2.6	1.7	1.2	.4	0
20	10	2.6	2.6	1.3	.4	0
20	11	0	0	0	0	0
20	12	0	0	0	0	0
20	13	0	0	0	0	0
20	14	.3	0	0	0	0
20	15	8.5	8.5	0	0	0
20	16	6.0	6.0	0	0	0
20	17	14.9	0	0	0	0
20	18	21.9	0	0	0	0
20	19	7.9	0	0	0	0
20	20	3.5	0	0	0	0
20	21	6.6	6.6	3.1	0	0
20	22	2.0	0	0	0	0
20	23	19.0	9.9	0	0	0
20	24	0	0	0	0	0
20	25	.1	0	0	0	0
20	26	2.5	2.5	1.0	0	0
20	27	0	0	0	0	0
20	28	14.7	13.3	0	0	0
20	29	28.2	28.2	0	0	0
20	30	19.0	17.6	0	0	0
20	31	26.8	26.8	0	0	0
20	32	14.3	14.3	0	0	0
20	33	17.8	17.8	0	0	0
20	34	18.0	18.0	0	0	0
20	35	37.2	37.2	0	0	0
20	36	0	0	0	0	0
20	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
21	1	0	0	0	0	0
21	2	5.3	0	0	0	0
21	3	0	0	0	0	0
21	4	0	0	0	0	0
21	5	.6	.6	.6	.6	0
21	6	0	0	0	0	0
21	7	0	0	0	0	0
21	8	.7	.4	.4	.4	0
21	9	1.6	1.6	1.0	.4	0
21	10	1.3	1.3	.6	0	0
21	11	0	0	0	0	0
21	12	3.8	0	0	0	0
21	13	14.9	0	0	0	0
21	14	0	0	0	0	0
21	15	7.7	7.7	1.2	0	0
21	16	16.9	12.1	0	0	0
21	17	19.4	7.4	0	0	0
21	18	19.4	7.4	0	0	0
21	19	5.8	1.6	0	0	0
21	20	2.2	0	0	0	0
21	21	1.3	1.3	0	0	0
21	22	1.2	0	0	0	0
21	23	6.0	0	0	0	0
21	24	.4	.4	.4	0	0
21	25	8.8	8.8	0	0	0
21	26	.9	.9	.9	0	0
21	27	.7	.7	.7	0	0
21	28	9.9	9.9	0	0	0
21	29	14.0	14.0	0	0	0
21	30	12.0	12.0	0	0	0
21	31	0	0	0	0	0
21	32	0	0	0	0	0
21	33	0	0	0	0	0
21	34	0	0	0	0	0
21	35	0	0	0	0	0
21	36	0	0	0	0	0
21	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
22	1	0	0	0	0	0
22	2	0	0	0	0	0
22	3	0	0	0	0	0
22	4	0	0	0	0	0
22	5	2.0	0	0	0	0
22	6	0	0	0	0	0
22	7	0	0	0	0	0
22	8	0	0	0	0	0
22	9	0	0	0	16.7	16.7
22	10	6.4	0	0	16.7	16.7
22	11	0	0	0	0	0
22	12	0	0	0	0	0
22	13	0	0	0	0	0
22	14	.4	.1	0	0	0
22	15	.3	0	0	0	0
22	16	2.9	1.5	0	0	0
22	17	4.2	2.5	0	0	0
22	18	3.9	2.5	0	0	0
22	19	5.8	2.8	0	0	0
22	20	3.1	2.8	0	0	0
22	21	0	0	0	0	0
22	22	0	0	0	0	0
22	23	0	0	0	0	0
22	24	.7	0	0	0	0
22	25	.3	.3	0	0	0
22	26	0	.6	0	0	0
22	27	.7	.7	0	0	0
22	28	2.2	2.2	0	0	0
22	29	.6	.6	0	0	0
22	30	1.0	1.0	0	0	0
22	31	0	0	0	0	0
22	32	0	0	0	0	0
22	33	0	0	0	0	0
22	34	0	0	0	0	0
22	35	0	0	0	0	0
22	36	0	0	0	0	0
22	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
23	1	0	0	0	0	0
23	2	0	0	0	0	0
23	3	0	0	0	0	0
23	4	0	0	0	0	0
23	5	.6	0	0	0	0
23	6	3.8	2.2	0	0	0
23	7	0	0	0	0	0
23	8	0	0	0	0	0
23	9	9.9	0	0	16.7	16.7
23	10	20.0	20.0	0	16.7	16.7
23	11	9.9	9.9	0	0	0
23	12	0	0	0	0	0
23	13	0	0	0	0	0
23	14	1.2	1.2	1.2	0	0
23	15	1.0	0	0	0	0
23	16	.7	.4	0	0	0
23	17	0	0	0	0	0
23	18	.4	.4	.4	.4	0
23	19	2.3	2.3	.4	.4	0
23	20	3.8	3.8	1.8	0	0
23	21	4.0	4.0	0	0	0
23	22	10.0	10.0	0	0	0
23	23	0	0	0	0	0
23	24	0	0	0	0	0
23	25	0	0	0	0	0
23	26	3.8	3.8	0	0	0
23	27	.4	.4	0	0	0
23	28	1.3	0	0	0	0
23	29	1.2	1.2	.6	0	0
23	30	.4	.4	.4	.4	0
23	31	0	0	0	0	0
23	32	0	0	0	0	0
23	33	0	0	0	0	0
23	34	0	0	0	0	0
23	35	0	0	0	0	0
23	36	0	0	0	0	0
23	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
24	1	0	0	0	0	0
24	2	0	0	0	0	0
24	3	0	0	0	0	0
24	4	0	0	0	0	0
24	5	0	0	0	0	0
24	6	12.6	5.9	0	0	0
24	7	7.0	7.0	0	0	0
24	8	2.3	.6	0	0	0
24	9	0	0	0	0	0
24	10	0	0	0	0	0
24	11	.7	.7	.7	.7	.7
24	12	0	0	0	0	0
24	13	1.5	1.5	0	0	0
24	14	.4	.4	.4	0	0
24	15	.6	.6	.6	.6	.6
24	16	.4	.4	.4	.4	.4
24	17	0	0	0	0	0
24	18	0	0	0	0	0
24	19	0	0	0	0	0
24	20	.7	.7	0	0	0
24	21	1.6	1.6	0	0	0
24	22	5.6	5.6	0	0	0
24	23	0	0	0	0	0
24	24	0	0	0	0	0
24	25	0	0	0	0	0
24	26	.7	.7	0	0	0
24	27	0	0	0	0	0
24	28	2.6	2.6	0	0	0
24	29	.6	0	0	0	0
24	30	0	0	0	0	0
24	31	0	0	0	0	0
24	32	0	0	0	0	0
24	33	0	0	0	0	0
24	34	0	0	0	0	0
24	35	0	0	0	0	0
24	36	0	0	0	0	0
24	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
25	1	0	0	0	0	0
25	2	0	0	0	0	0
25	3	0	0	0	0	0
25	4	0	0	0	0	0
25	5	0	0	0	0	0
25	6	6.1	1.3	.9	.9	.9
25	7	5.3	5.3	1.3	1.3	1.3
25	8	3.5	3.5	0	0	0
25	9	0	0	0	0	0
25	10	0	0	0	0	0
25	11	3.6	3.6	0	0	0
25	12	1.0	1.0	0	0	0
25	13	0	0	0	0	0
25	14	.9	.9	0	0	0
25	15	0	0	0	0	0
25	16	0	0	0	0	0
25	17	.7	.7	0	0	0
25	18	0	0	0	0	0
25	19	0	0	0	0	0
25	20	0	0	0	0	0
25	21	0	0	0	0	0
25	22	0	0	0	0	0
25	23	0	0	0	0	0
25	24	0	0	0	0	0
25	25	0	0	0	0	0
25	26	0	0	0	0	0
25	27	0	0	0	0	0
25	28	1.0	1.0	0	0	0
25	29	0	0	0	0	0
25	30	0	0	0	0	0
25	31	0	0	0	0	0
25	32	0	0	0	0	0
25	33	0	0	0	0	0
25	34	0	0	0	0	0
25	35	0	0	0	0	0
25	36	0	0	0	0	0
25	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
26	1	0	0	0	0	0
26	2	0	0	0	0	0
26	3	0	0	0	0	0
26	4	0	0	0	0	0
26	5	0	0	0	0	0
26	6	0	0	0	0	0
26	7	12.4	0	0	16.7	16.7
26	8	1.9	1.9	0	16.7	16.7
26	9	2.9	2.9	0	0	0
26	10	18.8	18.8	.9	.9	0
26	11	6.3	6.3	.4	.4	0
26	12	3.8	0	0	0	0
26	13	.6	0	0	.2	0
26	14	1.3	1.3	1.3	.9	0
26	15	0	0	0	0	0
26	16	1.0	1.0	1.0	0	0
26	17	2.0	1.1	1.1	.4	0
26	18	0	0	0	0	0
26	19	0	0	0	0	0
26	20	0	0	0	0	0
26	21	0	0	0	0	0
26	22	0	0	0	0	0
26	23	0	0	0	0	0
26	24	0	0	0	0	0
26	25	2.5	2.5	1.2	0	0
26	26	0	0	0	0	0
26	27	.4	.4	.4	0	0
26	28	1.6	1.6	.9	0	0
26	29	0	0	0	0	0
26	30	1.9	0	0	0	0
26	31	0	0	0	0	0
26	32	0	0	0	0	0
26	33	0	0	0	0	0
26	34	0	0	0	0	0
26	35	0	0	0	0	0
26	36	0	0	0	0	0
26	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
27	1	0	0	0	0	0
27	2	0	0	0	0	0
27	3	0	0	0	0	0
27	4	0	0	0	0	0
27	5	0	0	0	0	0
27	6	0	0	0	0	0
27	7	0	0	0	16.7	16.7
27	8	9.9	9.9	0	16.7	16.7
27	9	3.2	3.2	0	0	0
27	10	3.6	3.6	3.3	3.3	0
27	11	0	0	0	0	0
27	12	0	0	0	0	0
27	13	0	0	0	0	0
27	14	.6	.6	0	0	0
27	15	1.5	1.5	.9	.5	0
27	16	2.0	2.0	1.0	0	0
27	17	0	0	0	0	0
27	18	0	0	0	.2	0
27	19	1.8	.5	.5	0	0
27	20	0	0	0	0	0
27	21	.7	.7	.7	0	0
27	22	5.0	5.0	0	0	0
27	23	9.9	9.9	0	0	0
27	24	1.3	0	0	0	0
27	25	18.7	1.3	1.3	0	0
27	26	.6	.6	.6	0	0
27	27	2.0	2.0	.9	0	0
27	28	.6	.6	.6	0	0
27	29	0	0	0	0	0
27	30	14.6	0	0	0	0
27	31	0	0	0	0	0
27	32	0	0	0	0	0
27	33	0	0	0	0	0
27	34	0	0	0	0	0
27	35	0	0	0	0	0
27	36	0	0	0	0	0
27	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
28	1	0	0	0	0	0
28	2	0	0	0	0	0
28	3	0	0	0	0	0
28	4	0	0	0	0	0
28	5	0	0	0	0	0
28	6	0	0	0	0	0
28	7	0	0	0	0	0
28	8	0	0	0	16.7	16.7
28	9	2.0	.4	0	16.7	16.7
28	10	2.0	2.0	.9	16.7	16.7
28	11	.7	.7	0	0	0
28	12	1.0	0	0	0	0
28	13	0	0	0	0	0
28	14	1.6	.4	0	0	0
28	15	1.6	.4	0	0	0
28	16	1.6	1.6	0	0	0
28	17	.6	.6	0	0	0
28	18	0	0	0	0	0
28	19	0	0	0	0	0
28	20	1.2	1.2	.5	.5	0
28	21	.4	.4	0	0	0
28	22	1.0	1.0	0	0	0
28	23	1.0	1.0	0	0	0
28	24	1.5	0	0	0	0
28	25	10.4	0	0	0	0
28	26	10.4	0	0	0	0
28	27	0	0	0	0	0
28	28	0	0	0	0	0
28	29	0	0	0	0	0
28	30	0	0	0	0	0
28	31	0	0	0	0	0
28	32	0	0	0	0	0
28	33	0	0	0	0	0
28	34	0	0	0	0	0
28	35	0	0	0	0	0
28	36	0	0	0	0	0
28	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
29	1	0	0	0	0	0
29	2	0	0	0	0	0
29	3	0	0	0	0	0
29	4	0	0	0	0	0
29	5	0	0	0	0	0
29	6	0	0	0	0	0
29	7	0	0	0	0	0
29	8	0	0	0	0	0
29	9	0	0	0	16.7	16.7
29	10	.6	0	0	16.7	16.7
29	11	2.6	2.5	0	0	0
29	12	0	0	0	0	0
29	13	0	0	0	0	0
29	14	0	0	0	0	0
29	15	.6	0	0	0	0
29	16	2.0	2.0	0	.6	0
29	17	2.0	2.0	0	.4	0
29	18	1.0	1.0	1.0	1.0	0
29	19	0	0	0	0	0
29	20	0	0	0	0	0
29	21	0	0	0	0	0
29	22	1.2	0	0	0	0
29	23	5.3	1.2	1.2	1.2	0
29	24	1.8	.5	.5	.5	0
29	25	9.2	0	0	0	0
29	26	13.4	0	0	0	0
29	27	0	0	0	0	0
29	28	0	0	0	0	0
29	29	0	0	0	0	0
29	30	0	0	0	0	0
29	31	0	0	0	0	0
29	32	0	0	0	0	0
29	33	0	0	0	0	0
29	34	0	0	0	0	0
29	35	0	0	0	0	0
29	36	0	0	0	0	0
29	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
30	1	0	0	0	0	0
30	2	0	0	0	0	0
30	3	0	0	0	0	0
30	4	0	0	0	0	0
30	5	0	0	0	0	0
30	6	0	0	0	0	0
30	7	0	0	0	0	0
30	8	0	0	0	0	0
30	9	0	0	0	0	0
30	10	0	0	0	0	0
30	11	.6	.6	0	0	0
30	12	0	0	0	0	0
30	13	0	0	0	0	0
30	14	0	0	0	0	0
30	15	0	0	0	0	0
30	16	3.2	3.2	.4	.4	0
30	17	.7	.7	.7	0	0
30	18	0	0	0	0	0
30	19	0	0	0	0	0
30	20	0	0	0	0	0
30	21	0	0	0	0	0
30	22	0	0	0	0	0
30	23	0	0	0	0	0
30	24	0	0	0	0	0
30	25	0	0	0	0	0
30	26	0	0	0	0	0
30	27	0	0	0	0	0
30	28	0	0	0	0	0
30	29	0	0	0	0	0
30	30	0	0	0	0	0
30	31	0	0	0	0	0
30	32	0	0	0	0	0
30	33	0	0	0	0	0
30	34	0	0	0	0	0
30	35	0	0	0	0	0
30	36	0	0	0	0	0
30	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
31	1	0	0	0	0	0
31	2	0	0	0	0	0
31	3	0	0	0	0	0
31	4	0	0	0	0	0
31	5	0	0	0	0	0
31	6	0	0	0	0	0
31	7	0	0	0	0	0
31	8	0	0	0	0	0
31	9	0	0	0	0	0
31	10	0	0	0	0	0
31	11	1.6	1.6	.9	0	0
31	12	1.8	0	0	0	0
31	13	2.2	0	0	0	0
31	14	0	0	0	0	0
31	15	2.0	0	0	0	0
31	16	2.0	0	0	0	0
31	17	.9	0	0	0	0
31	18	0	0	0	0	0
31	19	0	0	0	0	0
31	20	0	0	0	0	0
31	21	0	0	0	0	0
31	22	0	0	0	0	0
31	23	0	0	0	0	0
31	24	0	0	0	0	0
31	25	0	0	0	0	0
31	26	0	0	0	0	0
31	27	0	0	0	0	0
31	28	0	0	0	0	0
31	29	0	0	0	0	0
31	30	0	0	0	0	0
31	31	0	0	0	0	0
31	32	0	0	0	0	0
31	33	0	0	0	0	0
31	34	0	0	0	0	0
31	35	0	0	0	0	0
31	36	0	0	0	0	0
31	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
32	1	0	0	0	0	0
32	2	0	0	0	0	0
32	3	0	0	0	0	0
32	4	0	0	0	0	0
32	5	0	0	0	0	0
32	6	16.0	16.0	0	0	0
32	7	16.0	16.0	0	0	0
32	8	3.2	3.2	0	0	0
32	9	.6	.6	0	0	0
32	10	0	0	0	0	0
32	11	0	0	0	0	0
32	12	0	0	0	0	0
32	13	0	0	0	0	0
32	14	0	0	0	0	0
32	15	0	0	0	0	0
32	16	0	0	0	0	0
32	17	0	0	0	0	0
32	18	0	0	0	0	0
32	19	0	0	0	0	0
32	20	0	0	0	0	0
32	21	0	0	0	0	0
32	22	0	0	0	0	0
32	23	0	0	0	0	0
32	24	0	0	0	0	0
32	25	0	0	0	0	0
32	26	0	0	0	0	0
32	27	0	0	0	0	0
32	28	0	0	0	0	0
32	29	0	0	0	0	0
32	30	0	0	0	0	0
32	31	0	0	0	0	0
32	32	0	0	0	0	0
32	33	0	0	0	0	0
32	34	0	0	0	0	0
32	35	0	0	0	0	0
32	36	0	0	0	0	0
32	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
33	1	0	0	0	0	0
33	2	0	0	0	0	0
33	3	0	0	0	0	0
33	4	0	0	0	0	0
33	5	12.4	12.4	0	0	0
33	6	12.0	12.0	0	0	0
33	7	30.0	30.0	0	0	0
33	8	10.0	10.0	0	0	0
33	9	3.7	3.6	0	0	0
33	10	0	0	0	0	0
33	11	0	0	0	0	0
33	12	0	0	0	0	0
33	13	0	0	0	0	0
33	14	0	0	0	0	0
33	15	0	0	0	0	0
33	16	0	0	0	0	0
33	17	0	0	0	0	0
33	18	0	0	0	0	0
33	19	0	0	0	0	0
33	20	0	0	0	0	0
33	21	0	0	0	0	0
33	22	0	0	0	0	0
33	23	0	0	0	0	0
33	24	0	0	0	0	0
33	25	0	0	0	0	0
33	26	0	0	0	0	0
33	27	0	0	0	0	0
33	28	0	0	0	0	0
33	29	0	0	0	0	0
33	30	0	0	0	0	0
33	31	0	0	0	0	0
33	32	0	0	0	0	0
33	33	0	0	0	0	0
33	34	0	0	0	0	0
33	35	0	0	0	0	0
33	36	0	0	0	0	0
33	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
34	1	0	0	0	0	0
34	2	0	0	0	0	0
34	3	0	0	0	0	0
34	4	0	0	0	0	0
34	5	0	0	0	0	0
34	6	0	0	0	0	0
34	7	8.0	8.0	0	0	0
34	8	4.0	4.0	0	0	0
34	9	0	0	0	0	0
34	10	0	0	0	0	0
34	11	0	0	0	0	0
34	12	0	0	0	0	0
34	13	0	0	0	0	0
34	14	0	0	0	0	0
34	15	0	0	0	0	0
34	16	0	0	0	0	0
34	17	0	0	0	0	0
34	18	0	0	0	0	0
34	19	0	0	0	0	0
34	20	0	0	0	0	0
34	21	0	0	0	0	0
34	22	0	0	0	0	0
34	23	0	0	0	0	0
34	24	0	0	0	0	0
34	25	0	0	0	0	0
34	26	0	0	0	0	0
34	27	0	0	0	0	0
34	28	0	0	0	0	0
34	29	0	0	0	0	0
34	30	0	0	0	0	0
34	31	0	0	0	0	0
34	32	0	0	0	0	0
34	33	0	0	0	0	0
34	34	0	0	0	0	0
34	35	0	0	0	0	0
34	36	0	0	0	0	0
34	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
35	1	0	0	0	0	0
35	2	0	0	0	0	0
35	3	0	0	0	0	0
35	4	0	0	0	0	0
35	5	0	0	0	0	0
35	6	0	0	0	0	0
35	7	0	0	0	0	0
35	8	0	0	0	0	0
35	9	0	0	0	0	0
35	10	0	0	0	0	0
35	11	0	0	0	0	0
35	12	0	0	0	0	0
35	13	0	0	0	0	0
35	14	0	0	0	0	0
35	15	.6	0	0	0	0
35	16	0	0	0	0	0
35	17	0	0	0	0	0
35	18	0	0	0	0	0
35	19	0	0	0	0	0
35	20	0	0	0	0	0
35	21	0	0	0	0	0
35	22	0	0	0	0	0
35	23	0	0	0	0	0
35	24	0	0	0	0	0
35	25	0	0	0	0	0
35	26	0	0	0	0	0
35	27	0	0	0	0	0
35	28	0	0	0	0	0
35	29	0	0	0	0	0
35	30	0	0	0	0	0
35	31	0	0	0	0	0
35	32	0	0	0	0	0
35	33	0	0	0	0	0
35	34	0	0	0	0	0
35	35	0	0	0	0	0
35	36	0	0	0	0	0
35	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
36	1	0	0	0	0	0
36	2	0	0	0	0	0
36	3	0	0	0	0	0
36	4	0	0	0	0	0
36	5	0	0	0	0	0
36	6	0	0	0	0	0
36	7	0	0	0	0	0
36	8	0	0	0	0	0
36	9	0	0	0	0	0
36	10	0	0	0	0	0
36	11	0	0	0	0	0
36	12	0	0	0	0	0
36	13	0	0	0	0	0
36	14	0	0	0	0	0
36	15	0	0	0	0	0
36	16	0	0	0	0	0
36	17	0	0	0	0	0
36	18	0	0	0	0	0
36	19	0	0	0	0	0
36	20	0	0	0	0	0
36	21	0	0	0	0	0
36	22	0	0	0	0	0
36	23	0	0	0	0	0
36	24	0	0	0	0	0
36	25	0	0	0	0	0
36	26	0	0	0	0	0
36	27	0	0	0	0	0
36	28	0	0	0	0	0
36	29	0	0	0	0	0
36	30	0	0	0	0	0
36	31	0	0	0	0	0
36	32	0	0	0	0	0
36	33	0	0	0	0	0
36	34	0	0	0	0	0
36	35	0	0	0	0	0
36	36	0	0	0	0	0
36	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
37	1	0	0	0	0	0
37	2	0	0	0	0	0
37	3	0	0	0	0	0
37	4	0	0	0	0	0
37	5	0	0	0	0	0
37	6	0	0	0	0	0
37	7	0	0	0	0	0
37	8	0	0	0	0	0
37	9	0	0	0	0	0
37	10	0	0	0	0	0
37	11	0	0	0	0	0
37	12	0	0	0	0	0
37	13	0	0	0	0	0
37	14	0	0	0	0	0
37	15	0	0	0	0	0
37	16	0	0	0	0	0
37	17	0	0	0	0	0
37	18	0	0	0	0	0
37	19	0	0	0	0	0
37	20	0	0	0	0	0
37	21	0	0	0	0	0
37	22	0	0	0	0	0
37	23	0	0	0	0	0
37	24	0	0	0	0	0
37	25	0	0	0	0	0
37	26	0	0	0	0	0
37	27	0	0	0	0	0
37	28	0	0	0	0	0
37	29	0	0	0	0	0
37	30	0	0	0	0	0
37	31	0	0	0	0	0
37	32	0	0	0	0	0
37	33	0	0	0	0	0
37	34	0	0	0	0	0
37	35	0	0	0	0	0
37	36	0	0	0	0	0
37	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
38	1	0	0	0	0	0
38	2	0	0	0	0	0
38	3	0	0	0	0	0
38	4	0	0	0	0	0
38	5	0	0	0	0	0
38	6	0	0	0	0	0
38	7	0	0	0	0	0
38	8	0	0	0	0	0
38	9	0	0	0	0	0
38	10	0	0	0	0	0
38	11	0	0	0	0	0
38	12	0	0	0	0	0
38	13	0	0	0	0	0
38	14	0	0	0	0	0
38	15	0	0	0	0	0
38	16	0	0	0	0	0
38	17	0	0	0	0	0
38	18	0	0	0	0	0
38	19	0	0	0	0	0
38	20	0	0	0	0	0
38	21	0	0	0	0	0
38	22	0	0	0	0	0
38	23	0	0	0	0	0
38	24	0	0	0	0	0
38	25	0	0	0	0	0
38	26	0	0	0	0	0
38	27	0	0	0	0	0
38	28	0	0	0	0	0
38	29	0	0	0	0	0
38	30	0	0	0	0	0
38	31	0	0	0	0	0
38	32	0	0	0	0	0
38	33	0	0	0	0	0
38	34	0	0	0	0	0
38	35	0	0	0	0	0
38	36	0	0	0	0	0
38	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
39	1	0	0	0	0	0
39	2	0	0	0	0	0
39	3	0	0	0	0	0
39	4	0	0	0	0	0
39	5	0	0	0	0	0
39	6	0	0	0	0	0
39	7	0	0	0	0	0
39	8	0	0	0	0	0
39	9	0	0	0	0	0
39	10	0	0	0	0	0
39	11	0	0	0	0	0
39	12	0	0	0	0	0
39	13	0	0	0	0	0
39	14	0	0	0	0	0
39	15	0	0	0	0	0
39	16	0	0	0	0	0
39	17	0	0	0	0	0
39	18	0	0	0	0	0
39	19	0	0	0	0	0
39	20	0	0	0	0	0
39	21	0	0	0	0	0
39	22	0	0	0	0	0
39	23	0	0	0	0	0
39	24	0	0	0	0	0
39	25	0	0	0	0	0
39	26	0	0	0	0	0
39	27	0	0	0	0	0
39	28	0	0	0	0	0
39	29	0	0	0	0	0
39	30	0	0	0	0	0
39	31	0	0	0	0	0
39	32	0	0	0	0	0
39	33	0	0	0	0	0
39	34	0	0	0	0	0
39	35	0	0	0	0	0
39	36	0	0	0	0	0
39	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
40	1	0	0	0	0	0
40	2	0	0	0	0	0
40	3	0	0	0	0	0
40	4	0	0	0	0	0
40	5	0	0	0	0	0
40	6	0	0	0	0	0
40	7	0	0	0	0	0
40	8	0	0	0	0	0
40	9	0	0	0	0	0
40	10	0	0	0	0	0
40	11	0	0	0	0	0
40	12	0	0	0	0	0
40	13	0	0	0	0	0
40	14	0	0	0	0	0
40	15	0	0	0	0	0
40	16	0	0	0	0	0
40	17	0	0	0	0	0
40	18	0	0	0	0	0
40	19	0	0	0	0	0
40	20	0	0	0	0	0
40	21	0	0	0	0	0
40	22	0	0	0	0	0
40	23	0	0	0	0	0
40	24	0	0	0	0	0
40	25	0	0	0	0	0
40	26	0	0	0	0	0
40	27	0	0	0	0	0
40	28	0	0	0	0	0
40	29	0	0	0	0	0
40	30	0	0	0	0	0
40	31	0	0	0	0	0
40	32	0	0	0	0	0
40	33	0	0	0	0	0
40	34	0	0	0	0	0
40	35	0	0	0	0	0
40	36	0	0	0	0	0
40	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
41	1	0	0	0	0	0
41	2	0	0	0	0	0
41	3	0	0	0	0	0
41	4	0	0	0	0	0
41	5	0	0	0	0	0
41	6	0	0	0	0	0
41	7	0	0	0	0	0
41	8	0	0	0	0	0
41	9	0	0	0	0	0
41	10	0	0	0	0	0
41	11	0	0	0	0	0
41	12	0	0	0	0	0
41	13	0	0	0	0	0
41	14	0	0	0	0	0
41	15	0	0	0	0	0
41	16	0	0	0	0	0
41	17	0	0	0	0	0
41	18	0	0	0	0	0
41	19	0	0	0	0	0
41	20	0	0	0	0	0
41	21	0	0	0	0	0
41	22	0	0	0	0	0
41	23	0	0	0	0	0
41	24	0	0	0	0	0
41	25	0	0	0	0	0
41	26	0	0	0	0	0
41	27	0	0	0	0	0
41	28	0	0	0	0	0
41	29	0	0	0	0	0
41	30	0	0	0	0	0
41	31	0	0	0	0	0
41	32	0	0	0	0	0
41	33	0	0	0	0	0
41	34	0	0	0	0	0
41	35	0	0	0	0	0
41	36	0	0	0	0	0
41	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
42	1	0	0	0	0	0
42	2	0	0	0	0	0
42	3	0	0	0	0	0
42	4	0	0	0	0	0
42	5	0	0	0	0	0
42	6	0	0	0	0	0
42	7	0	0	0	0	0
42	8	0	0	0	0	0
42	9	0	0	0	0	0
42	10	0	0	0	0	0
42	11	0	0	0	0	0
42	12	0	0	0	0	0
42	13	0	0	0	0	0
42	14	0	0	0	0	0
42	15	0	0	0	0	0
42	16	0	0	0	0	0
42	17	0	0	0	0	0
42	18	0	0	0	0	0
42	19	0	0	0	0	0
42	20	0	0	0	0	0
42	21	0	0	0	0	0
42	22	0	0	0	0	0
42	23	0	0	0	0	0
42	24	0	0	0	0	0
42	25	0	0	0	0	0
42	26	0	0	0	0	0
42	27	0	0	0	0	0
42	28	0	0	0	0	0
42	29	0	0	0	0	0
42	30	0	0	0	0	0
42	31	0	0	0	0	0
42	32	0	0	0	0	0
42	33	0	0	0	0	0
42	34	0	0	0	0	0
42	35	0	0	0	0	0
42	36	0	0	0	0	0
42	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
43	1	0	0	0	0	0
43	2	0	0	0	0	0
43	3	0	0	0	0	0
43	4	0	0	0	0	0
43	5	0	0	0	0	0
43	6	0	0	0	0	0
43	7	0	0	0	0	0
43	8	0	0	0	0	0
43	9	0	0	0	0	0
43	10	0	0	0	0	0
43	11	0	0	0	0	0
43	12	0	0	0	0	0
43	13	0	0	0	0	0
43	14	0	0	0	0	0
43	15	0	0	0	0	0
43	16	0	0	0	0	0
43	17	0	0	0	0	0
43	18	0	0	0	0	0
43	19	0	0	0	0	0
43	20	0	0	0	0	0
43	21	0	0	0	0	0
43	22	0	0	0	0	0
43	23	0	0	0	0	0
43	24	0	0	0	0	0
43	25	0	0	0	0	0
43	26	0	0	0	0	0
43	27	0	0	0	0	0
43	28	0	0	0	0	0
43	29	0	0	0	0	0
43	30	0	0	0	0	0
43	31	0	0	0	0	0
43	32	0	0	0	0	0
43	33	0	0	0	0	0
43	34	0	0	0	0	0
43	35	0	0	0	0	0
43	36	0	0	0	0	0
43	37	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
44	1	0	0	0	0	0
44	2	0	0	0	0	0
44	3	0	0	0	0	0
44	4	0	0	0	0	0
44	5	0	0	0	0	0
44	6	0	0	0	0	0
44	7	0	0	0	0	0
44	8	0	0	0	0	0
44	9	0	0	0	0	0
44	10	0	0	0	0	0
44	11	0	0	0	0	0
44	12	0	0	0	0	0
44	13	0	0	0	0	0
44	14	0	0	0	0	0
44	15	0	0	0	0	0
44	16	0	0	0	0	0
44	17	0	0	0	0	0
44	18	0	0	0	0	0
44	19	0	0	0	0	0
44	20	0	0	0	0	0
44	21	0	0	0	0	0
44	22	0	0	0	0	0
44	23	0	0	0	0	0
44	24	0	0	0	0	0
44	25	0	0	0	0	0
44	26	0	0	0	0	0
44	27	0	0	0	0	0
44	28	0	0	0	[illegible]	0
44	29	0	0	0	0	0
44	30	0	0	0	0	0
44	31	0	0	0	0	0
44	32	0	0	0	0	0
44	33	0	0	0	0	0
44	34	0	0	0	0	0
44	35	0	0	0	0	0
44	36	0	0	0	0	0
44	37	0	0	0	0	0

Part 3. Northeast Subarea - Recharge in gal/min.

NODE POINT						
Col.	Row	1972	1965	1956	1950	1943
1	32	8.3				
1	33	43.5				
1	34	1.5				
1	35	12.8				
1	36	0				
1	37	1.9				
1	38	17.5				
1	39	3.2				
1	40	1.9				
1	41	0				
1	42	0				
1	43	0				
1	44	0				
1	45	0				
1	46	0				
1	47	0				

Col.	Row	1972	1965	1958	1950	1943
2	33	0	0	0	11.6	11.6
2	34	20.0	20.0	0	11.6	11.6
2	35	4.0	4.0	0	11.6	11.6
2	36	28.0	28.0	28.0	28.0	28.0
2	37	1.3	1.3	1.3	1.3	1.3
2	38	1.2	1.2	1.2	1.2	1.2
2	39	4.7	4.7	4.7	4.7	3.1
2	40	3.9	3.9	3.9	3.9	3.1
2	41	0	0	0	0	0
2	42	0	0	0	0	0
2	43	0	0	0	0	0
2	44	0	0	0	0	0
2	45	0	0	0	0	0
2	46	0	0	0	0	0
2	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
3	32	1.9	1.9	1.9	7.0	7.0
3	33	.8	.8	.8	11.6	11.6
3	34	8.0	8.0	0	18.8	18.8
3	35	1.6	1.6	0	11.6	11.6
3	36	28.0	28.0	28.0	28.0	28.0
3	37	5.7	5.7	5.7	5.7	5.7
3	38	4.5	4.5	4.5	4.5	4.5
3	39	2.0	2.0	2.0	2.0	0
3	40	1.3	1.3	1.3	1.3	0
3	41	3.9	3.9	3.9	0	0
3	42	39.4	39.4	39.4	0	0
3	43	0	0	0	0	0
3	44	0	0	0	0	0
3	45	0	0	0	0	0
3	46	0	0	0	0	0
3	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
4	26	12.0	12.0	12.0	12.0	12.0
4	27	2.2	2.2	2.2	2.2	2.2
4	28	8.3	8.3	8.3	8.3	8.3
4	29	5.0	5.0	5.0	5.0	5.0
4	30	5.7	5.7	5.7	5.7	5.7
4	31	5.7	5.7	5.7	11.6	11.6
4	32	5.6	5.6	5.6	18.8	18.8
4	33	2.3	2.3	2.3	18.8	18.8
4	34	3.3	3.3	3.3	18.8	18.8
4	35	15.5	15.5	15.5	11.6	11.6
4	36	10.4	10.4	10.4	7.0	7.0
4	37	11.1	11.1	11.1	0	0
4	38	9.8	9.8	9.8	2.4	0
4	39	0	0	0	0	0
4	40	0	0	0	0	0
4	41	0	0	0	0	0
4	42	5.7	5.7	5.7	5.7	0
4	43	13.7	13.7	5.7	5.7	0
4	44	12.5	12.5	12.5	0	0
4	45	0	0	0	0	0
4	46	0	0	0	0	0
4	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
5	22	14.6	14.6	14.6	0	0
5	23	17.8	17.8	17.8	0	0
5	24	15.7	15.7	15.7	0	0
5	25	11.7	11.7	11.7	11.7	11.7
5	26	0	0	0	0	0
5	27	12.3	12.3	12.3	0	0
5	28	16.0	16.0	16.0	7.3	5.8
5	29	15.7	15.7	15.7	15.7	15.7
5	30	17.8	17.8	5.7	5.7	5.7
5	31	10.1	10.1	3.2	11.6	11.6
5	32	11.7	11.7	3.8	18.8	18.8
5	33	17.8	17.8	5.7	18.8	18.8
5	34	17.1	17.1	5.5	18.8	18.8
5	35	10.4	10.4	3.3	11.6	11.6
5	36	1.3	1.3	1.3	0	0
5	37	12.5	12.5	12.5	0	0
5	38	13.1	13.1	13.1	0	0
5	39	0	0	0	0	0
5	40	34.5	34.5	0	0	0
5	41	37.2	37.2	0	0	0
5	42	5.7	5.7	5.7	5.7	5.7
5	43	11.7	11.7	11.7	11.7	11.7
5	44	12.4	12.4	12.4	.7	.7
5	45	11.2	11.2	11.2	.3	.3
5	46	12.0	12.0	12.0	0	0
5	47					

Col.	Row	1972	1965	1958	1950	1943
6	20	0	0	0	0	0
6	21	7.4	7.4	7.4	0	0
6	22	25.1	25.1	25.1	0	0
6	23	14.6	14.6	14.6	0	0
6	24	19.1	19.1	19.1	0	0
6	25	6.7	6.7	6.7	6.7	6.7
6	26	.6	.6	.6	.6	.6
6	27	14.4	14.4	14.4	0	0
6	28	8.9	8.9	8.9	4.4	4.4
6	29	14.0	14.0	14.0	14.0	14.0
6	30	16.0	16.0	16.0	5.2	5.2
6	31	1.3	1.3	1.3		
6	32	4.5	4.5	4.5		
6	33	1.8	1.8	1.8		
6	34	15.7	15.7	15.7		
6	35	7.6	7.6	7.6		
6	36	0	0	0	0	0
6	37	14.6	14.6	14.6	0	0
6	38	21.9	21.9	21.9	0	0
6	39	5.0	5.0	0	0	0
6	40	3.8	3.8	0	0	0
6	41	6.9	6.9	0	0	0
6	42	3.2	3.2	3.2	3.2	3.2
6	43	16.9	16.9	3.2	3.2	3.2
6	44	17.1	17.1	0	0	0
6	45	15.7	15.7	0	0	0
6	46	5.0	5.0	0	0	0
6	47					

Col.	Row	1972	1965	1958	1950	1943
7	15	4.4	.3	.3	.3	.3
7	16	20.9	.9	.9	.9	.9
7	17	15.7	8.2	3.4	0	0
7	18	6.0	1.5	1.5	0	0
7	19	0	0	0	0	0
7	20	0	0	0	0	0
7	21	22.3	22.3	0	0	0
7	22	30.1	30.1	30.1	0	0
7	23	13.4	13.4	13.4	0	0
7	24	7.1	7.1	7.1	1.5	0
7	25	1.2	1.2	1.2	1.2	0
7	26	3.8	3.8	3.8	3.8	0
7	27	14.4	14.4	14.4	14.4	0
7	28	12.4	12.4	.3	.3	0
7	29	2.0	2.0	.3	.3	0
7	30	3.8	3.8	.3	.3	0
7	31	1.3	1.3	.9	.9	0
7	32	0	0	0	.7	0
7	33	4.5	4.5	4.5	0	0
7	34	17.1	17.1	17.1	0	0
7	35	23.0	23.0	23.0	0	0
7	36	11.8	11.8	.3	.3	0
7	37	17.8	17.8	17.8	0	0
7	38	17.2	17.2	17.2	0	0
7	39	10.1	10.1	10.1	4.5	3.1
7	40	19.5	19.5	19.5	19.5	12.0
7	41	13.4	13.4	13.4	13.4	13.4
7	42	6.0	6.0	6.0	6.0	6.0
7	43	6.7	6.7	6.7	6.7	6.7
7	44	15.7	15.7	7.6	0	0
7	45	17.1	17.1	12.3	0	0
7	46	16.0	16.0	9.2	0	0
7	47	8.5	8.5	3.5	0	0

Col.	Row	1972	1965	1958	1950	1943
8	15	.6	.6	.3	0	0
8	16	3.9	3.9	1.6	.3	0
8	17	17.8	17.8	8.9	0	0
8	18	13.4	13.4	9.0	0	0
8	19	3.8	3.8	1.6	0	0
8	20	1.3	0	0	0	0
8	21	16.8	16.8	0	0	0
8	22	11.7	11.7	6.0	0	0
8	23	7.9	7.9	3.5	0	0
8	24	2.9	2.9	2.9	2.9	0
8	25	0	0	0	0	0
8	26	7.4	7.4	4.7	4.7	4.7
8	27	24.8	24.8	4.7	4.7	4.7
8	28	37.2	37.2	37.2	0	0
8	29	1.3	1.3	1.3	.9	0
8	30	1.5	1.5	1.5	.4	0
8	31	0	0	0	0	0
8	32	0	0		.6	0
8	33	.7	.7	.7	0	0
8	34	8.9	8.9	8.9	0	0
8	35	17.8	17.8		0	0
8	36	17.8	0	0	0	0
8	37	17.8	17.8	17.8	0	0
8	38	26.6	26.6	6.9	0	0
8	39	9.8	9.8	9.8	9.8	0
8	40	7.1	7.1	7.1	7.1	0
8	41	4.1	4.1	4.1	4.1	0
8	42	12.5	12.5	12.5	12.5	0
8	43	1.5	1.5	1.5	1.5	0
8	44	4.4	4.4	2.0	0	0
8	45	15.2	15.2	5.4	0	0
8	46	21.0	21.0	10.4	0	0
8	47	8.6	8.6	4.5	0	0

Col.	Row	1972	1965	1958	1950	1943
9	15	0	0	0	0	0
9	16	3.5	0	0	0	0
9	17	17.8	0	0	0	0
9	18	17.1	17.1	0	0	0
9	19	14.6	0	0	0	0
9	20	0	0	0	0	0
9	21	8.9	8.9	0	0	0
9	22	12.0	12.0	1.5	1.5	1.5
9	23	.6	.6	.6	.4	0
9	24	0	0	0	0	0
9	25	.6	0	0	0	0
9	26	2.0	2.0	2.0	2.0	2.0
9	27	6.0	0	0	0	0
9	28	2.9	0	0	0	0
9	29	5.0	5.0	5.0	0	0
9	30	1.2	1.2	.6	0	0
9	31	0	0	0	0	0
9	32	0	0	0	0	0
9	33	1.5	0	0	0	0
9	34	13.4	13.4	8.9	0	0
9	35	17.8	17.8	9.0	0	0
9	36	17.8	17.8	9.0	0	0
9	37	17.8	17.8	12.1	0	0
9	38	14.6	14.6	14.6	0	0
9	39	8.6	8.6	8.6	8.6	0
9	40	5.1	5.1	5.1	5.1	0
9	41	5.5	5.5	5.5	5.5	0
9	42	3.9	3.9	3.9	3.9	0
9	43	1.3	1.3	1.3	1.3	0
9	44	1.3	1.3	1.3	0	0
9	45	1.3	1.3	.6	0	0
9	46	1.2	1.2	.7	0	0
9	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
10	15	0	0	0	0	0
10	16	1.8	1.8	.3	.3	0
10	17	8.6	.9	.3	.3	0
10	18	13.8	3.8	1.8	0	0
10	19	9.5	0	0	0	0
10	20	0	0	0	0	0
10	21	6.2	6.2	3.4	0	0
10	22	1.5	1.5	1.5	0	0
10	23	.6	.3	.3	.3	0
10	24	.6	0	0	0	0
10	25	5.7	5.7	5.7	5.7	0
10	26	0	0	0	0	0
10	27	0	0	0	0	0
10	28	0	0	0	0	0
10	29	0	0	0	0	0
10	30	0	0	0	0	0
10	31	0	0	0	0	0
10	32	0	0	0	0	0
10	33	0	0	0	0	0
10	34	11.7	11.7	11.7	0	0
10	35	9.5	9.5	9.5	0	0
10	36	16.0	16.0	16.0	0	0
10	37	17.8	17.8	17.8	0	0
10	38	18.7	18.7	18.7	0	0
10	39	13.4	13.4	13.4	0	0
10	40	8.9	8.9	8.9	.3	0
10	41	3.5	3.5	3.5	0	0
10	42	1.3	1.3	1.3	0	0
10	43	6.0	6.0	3.1	0	0
10	44	0	0	0	0	0
10	45	1.3	1.3	1.3	1.3	0
10	46	5.7	5.7	2.0	0	0
10	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
11	15	1.0	1.0	0	0	0
11	16	6.2	6.2	0	0	0
11	17	0	0	0	0	0
11	18	1.3	0	0	0	0
11	19	1.3	0	0	0	0
11	20	1.3	0	0	0	0
11	21	0	0	0	0	0
11	22	0	0	0	0	0
11	23	0	0	0	0	0
11	24	1.0	0	0	0	0
11	25	6.1	6.1	6.1	6.1	2.9
11	26	0	0	0	0	0
11	27	0	0	0	0	0
11	28	0	0	0	0	0
11	29	0	0	0	0	0
11	30	0	0	0	0	0
11	31	3.8	3.8	0	0	0
11	32	0	0	0	0	0
11	33	0	0	0	0	0
11	34	7.4	7.4	0	0	0
11	35	2.9	2.9	2.9	0	0
11	36	8.3	0	0	0	0
11	37	17.8	17.8	9.6	0	0
11	38	17.8	17.8	10.5	0	0
11	39	2.9	2.9	0	0	0
11	40	5.7	5.7	2.5	0	0
11	41	0	0	0	0	0
11	42	10.2	10.2	0	0	0
11	43	16.0	0	0	0	0
11	44	13.1	1.8	.9	.9	0
11	45	6.2	1.8	.3	.3	0
11	46	4.8	4.8	0	0	0
11	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
12	15	14.0	14.0	0	0	0
12	16	11.1	11.1	0	0	0
12	17	.6	.6	0	0	0
12	18	1.3	0	0	0	0
12	19	.6	0	0	0	0
12	20	0	0	0	0	0
12	21	1.3	0	0	0	0
12	22	2.5	0	0	0	0
12	23	1.3	0	0	0	0
12	24	1.3	0	0	0	0
12	25	6.0	6.0	6.0	6.0	2.9
12	26	1.3	1.3	1.3	1.3	0
12	27	2.9	2.9	0	0	0
12	28	0	0	0	0	0
12	29	0	0	0	0	0
12	30	0	0	0	0	0
12	31	0	0	0	0	0
12	32	0	0	0	0	0
12	33	0	0	0	0	0
12	34	4.5	4.5	0	0	0
12	35	3.8	3.8	0	0	0
12	36	0	0	0	0	0
12	37	9.0	9.0	0	0	0
12	38	7.4	3.6	0	0	0
12	39	1.5	0	0	0	0
12	40	2.3	0	0	0	0
12	41	1.6	1.6	.6	.6	0
12	42	13.7	13.7	.6	.6	0
12	43	11.7	11.7	.9	0	0
12	44	8.6	8.6	1.5	0	0
12	45	2.2	2.2	.9	0	0
12	46	2.5	2.5	2.5	2.5	0
12	47	5.0	5.0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
13	15	12.5	12.5	0	0	0
13	16	13.7	13.7	0	0	0
13	17	5.0	0	0	0	0
13	18	0	0	0	0	0
13	19	0	0	0	0	0
13	20	2.5	2.5	2.5	2.5	0
13	21	0	0	0	0	0
13	22	1.3	0	0	0	0
13	23	0	0	0	0	0
13	24	2.9	0	0	0	0
13	25	6.0	6.0	0	0	0
13	26	2.2	2.2	0	0	0
13	27	5.5	5.5	0	0	0
13	28	0	0	0	0	0
13	29	0	0	0	0	0
13	30	0	0	0	0	0
13	31	0	0	0	0	0
13	32	0	0	0	0	0
13	33	0	0	0	0	0
13	34	1.5	0	0	0	0
13	35	4.5	4.5	0	0	0
13	36	2.5	2.5	0	0	0
13	37	0	0	0	0	0
13	38	1.9	1.5	.6	0	0
13	39	5.0	.6	.4	0	0
13	40	1.9	0	0	0	0
13	41	3.6	3.6	1.8	0	0
13	42	35.5	6.1	0	0	0
13	43	4.5	4.5	0	0	0
13	44	0	0	0	0	0
13	45	5.0	5.0	0	0	0
13	46	2.9	3.5	0	0	0
13	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
14	11	0	0	0	0	0
14	12	0	0	0	0	0
14	13	5.5	0	0	0	0
14	14	5.7	5.7	0	0	0
14	15	1.0	1.0	0	0	0
14	16	12.7	6.2	0	0	0
14	17	1.3	1.3	0	0	0
14	18	0	0	0	0	0
14	19	0	0	0	0	0
14	20	1.8	0	0	0	0
14	21	0	0	0	0	0
14	22	1.5	0	0	0	0
14	23	2.9	0	0	0	0
14	24	2.9	0	0	0	0
14	25	6.0	0	0	0	0
14	26	9.9	0	0	0	0
14	27	8.9	0	0	0	0
14	28	6.0	0	0	0	0
14	29	0	0	0	0	0
14	30	0	0	0	0	0
14	31	0	0	0	0	0
14	32	0	0	0	0	0
14	33	0	0	0	0	0
14	34	0	0	0	0	0
14	35	3.9	3.9	0	0	0
14	36	0	0	0	0	0
14	37	0	0	0	0	0
14	38	0	0	0	0	0
14	39	0	0	0	0	0
14	40	2.3	2.3	1.2	.3	0
14	41	.4	.4	.4	.6	0
14	42	1.5	1.5	.9	0	0
14	43	2.9	0	0	0	0
14	44	0	0	0	0	0
14	45	0	0	0	0	0
14	46	0	0	0	0	0
14	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
15	11	0	0	0	0	0
15	12	1.3	1.3	0	0	0
15	13	1.8	0	0	0	0
15	14	6.2	1.5	0	0	0
15	15	1.8	.9	0	0	0
15	16	0	0	0	0	0
15	17	1.3	0	0	0	0
15	18	1.3	1.3	0	0	0
15	19	0	0	0	0	0
15	20	0	0	0	0	0
15	21	0	0	0	0	0
15	22	0	0	0	0	0
15	23	0	0	0	0	0
15	24	0	0	0	0	0
15	25	0	0	0	0	0
15	26	12.0	12.0	0	0	0
15	27	11.7	11.7	0	0	0
15	28	0	0	0	0	0
15	29	0	0	0	0	0
15	30	0	0	0	0	0
15	31	0	0	0	0	0
15	32	0	0	0	0	0
15	33	0	0	0	0	0
15	34	0	0	0	0	0
15	35	1.5	.4	0	0	0
15	36	1.6	1.6	1.6	1.6	0
15	37	5.0	5.0	5.0	5.0	0
15	38	1.3	.6	.6	0	0
15	39	1.9	1.9	1.9	1.9	0
15	40	3.4	3.4	3.4	3.4	0
15	41	.9	.9	.9	0	0
15	42	4.4	2.2	.9	0	0
15	43	0	0	0	0	0
15	44	2.6	1.8	1.2	0	0
15	45	0	0	0	0	0
15	46	0	0	0	0	0
15	47	1.3	.6	.6	.6	0

Col.	Row	1972	1965	1958	1950	1943
16	5	0	0	0	0	0
16	6	0	0	0	0	0
16	7	0	0	0	0	0
16	8	0	0	0	0	0
16	9	0	0	0	0	0
16	10	0	0	0	0	0
16	11	0	0	0	0	0
16	12	0	0	0	0	0
16	13	2.2	0	0	0	0
16	14	7.0	7.0	0	0	0
16	15	1.9	1.9	0	0	0
16	16	0	0	0	0	0
16	17	.6	.6	0	0	0
16	18	14.6	14.6	0	0	0
16	19	8.0	8.0	0	0	0
16	20	0	0	0	0	0
16	21	0	0	0	0	0
16	22	0	0	0	0	0
16	23	0	0	0	0	0
16	24	0	0	0	0	0
16	25	0	0	0	0	0
16	26	0	0	0	0	0
16	27	0	0	0	0	0
16	28	0	0	0	0	0
16	29	0	0	0	0	0
16	30	0	0	0	0	0
16	31	0	0	0	0	0
16	32	0	0	0	0	0
16	33	0	0	0	0	0
16	34	0	0	0	0	0
16	35	0	0	0	0	0
16	36	2.6	1.8	1.3	1.3	0
16	37	1.9	.4	.4	.3	0
16	38	0	0	0	0	0
16	39	1.9	1.6	1.6	1.3	0
16	40	1.9	1.9	1.2	0	0
16	41	.6	.6	.6	0	0
16	42	1.2	.9	.9	0	0
16	43	1.0	0	0	0	0
16	44	1.0	0	0	0	0
16	45	0	0	0	0	0
16	46	0	0	0	0	0
16	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
17	5	2.9	0	0	0	0
17	6	.4	0	0	0	0
17	7	.4	0	0	0	0
17	8	0	0	0	0	0
17	9	0	0	0	0	0
17	10	0	0	0	0	0
17	11	0	0	0	0	0
17	12	0	0	0	0	0
17	13	7.7	7.7	0	0	0
17	14	1.8	0	0	0	0
17	15	5.1	3.5	3.8	0	0
17	16	14.6	14.0	0	0	0
17	17	15.6	15.6	0	0	0
17	18	0	0	0	0	0
17	19	0	0	0	0	0
17	20	0	0	0	0	0
17	21	0	0	0	0	0
17	22	0	0	0	0	0
17	23	.3	0	0	0	0
17	24	0	0	0	0	0
17	25	0	0	0	0	0
17	26	1.3	1.3	0	0	0
17	27	4.5	4.5	0	0	0
17	28	2.6	2.6	0	0	0
17	29	0	0	0	0	0
17	30	0	0	0	0	0
17	31	0	0	0	0	0
17	32	0	0	0	0	0
17	33	0	0	0	0	0
17	34	0	0	0	0	0
17	35	0	0	0	0	0
17	36	5.6	5.6	0	0	0
17	37	0	0	0	0	0
17	38	.6	.6	.3	0	0
17	39	1.3	1.3	1.3	0	0
17	40	0	0	0	0	0
17	41	4.5	4.5	1.8	0	0
17	42	2.9	2.9	1.5	0	0
17	43	.3	.3	.3	0	0
17	44	0	0	0	0	0
17	45	0	0	0	0	0
17	46	0	0	0	0	0
17	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
18	1	1.8	1.8	0	0	0
18	2	.6	.6	0	0	0
18	3	0	0	0	0	0
18	4	0	0	0	0	0
18	5	0	0	0	0	0
18	6	0	0	0	0	0
18	7	0	0	0	0	0
18	8	0	0	0	0	0
18	9	6.0	0	0	0	0
18	10	2.9	2.9	0	0	0
18	11	0	0	0	0	0
18	12	0	0	0	0	0
18	13	2.2	0	0	0	0
18	14	.7	.7	0	0	0
18	15	8.9	8.9	3.1	0	0
18	16	16.9	16.9	.3	.3	.3
18	17	14.9	14.9	0	0	0
18	18	.6	.6	0	0	0
18	19	.6	0	0	0	0
18	20	0	0	0	0	0
18	21	1.3	0	0	0	0
18	22	0	0	0	0	0
18	23	.6	0	0	0	0
18	24	0	0	0	0	0
18	25	0	0	0	0	0
18	26	0	0	0	0	0
18	27	8.9	8.9	0	0	0
18	28	2.9	2.9	0	0	0
18	29	0	0	0	0	0
18	30	0	0	0	0	0
18	31	0	0	0	0	0
18	32	0	0	0	0	0
18	33	0	0	0	0	0
18	34	0	0	0	0	0
18	35	0	0	0	0	0
18	36	.7	.7	.3	0	0
18	37	0	0	0	0	0
18	38	.1	0	0	0	0
18	39	.3	.3	.3	0	0
18	40	.3	.3	.3	0	0
18	41	15.6	7.4	1.6	0	0
18	42	8.6	0	0	0	0
18	43	0	0	0	0	0
18	44	0	0	0	0	0
18	45	0	0	0	0	0
18	46	0	0	0	0	0
18	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
19	3	1.9	1.9	0	0	0
19	4	1.9	1.9	0	0	0
19	5	0	0	0	0	0
19	6	0	0	0	0	0
19	7	0	0	0	0	0
19	8	0	0	0	0	0
19	9	8.6	0	0	0	0
19	10	6.0	6.0	0	0	0
19	11	0	0	0	0	0
19	12	0	0	0	0	0
19	13	0	0	0	0	0
19	14	0	0	0	0	0
19	15	7.4	7.4	0	0	0
19	16	11.4	11.4	0	0	0
19	17	14.3	14.3	0	0	0
19	18	0	0	0	0	0
19	19	0	0	0	0	0
19	20	0	0	0	0	0
19	21	0	0	0	0	0
19	22	.6	0	0	0	0
19	23	1.6	0	0	0	0
19	24	0	0	0	0	0
19	25	.1	.1	0	0	0
19	26	0	0	0	0	0
19	27	0	0	0	0	0
19	28	0	0	0	0	0
19	29	0	0	0	0	0
19	30	0	0	0	.3	.3
19	31	0	0	0	0	0
19	32	0	0	0	0	0
19	33	0	0	0	0	0
19	34	0	0	0	0	0
19	35	0	0	0	0	0
19	36	0	0	0	0	0
19	37	0	0	0	0	0
19	38	.7	.7	0	0	0
19	39	.7	.7	.3	0	0
19	40	0	0	0	0	0
19	41	0	0	0	0	0
19	42	4.5	0	0	0	0
19	43	0	0	0	0	0
19	44	0	0	0	0	0
19	45	0	0	0	0	0
19	46	0	0	0	0	0
19	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
20	2	3.8	0	0	0	0
20	3	3.2	0	0	0	0
20	4	0	0	0	0	0
20	5	0	0	0	0	0
20	6	17.8	17.8	0	0	0
20	7	8.9	8.9	0	0	0
20	8	4.5	0	0	0	0
20	9	6.9	0	0	0	0
20	10	0	0	0	0	0
20	11	0	0	0	0	0
20	12	3.9	0	0	0	0
20	13	2.9	2.9	0	0	0
20	14	.6	0	0	0	0
20	15	2.6	2.6	0	0	0
20	16	2.6	2.6	0	0	0
20	17	1.6	1.6	0	0	0
20	18	0	0	0	0	0
20	19	0	0	0	0	0
20	20	0	0	0	0	0
20	21	0	0	0	0	0
20	22	2.3	1.2	0	0	0
20	23	0	0	0	0	0
20	24	0	0	0	0	0
20	25	0	0	0	0	0
20	26	0	0	0	0	0
20	27	0	0	0	0	0
20	28	0	0	0	0	0
20	29	0	0	0	0	0
20	30	0	0	0	0	0
20	31	0	0	0	0	0
20	32	0	0	0	0	0
20	33	0	0	0	0	0
20	34	3.8	0	0	0	0
20	35	7.7	3.1	1.6	0	0
20	36	6.4	5.7	3.1	0	0
20	37	.6	.6	.6	0	0
20	38	0	0	0	0	0
20	39	.6	.6	.3	0	0
20	40	2.3	2.3	1.2	0	0
20	41	.3	.3	.3	.3	0
20	42	.3	.3	.3	0	0
20	43	0	0	0	0	0
20	44	0	0	0	0	0
20	45	0	0	0	0	0
20	46	0	0	0	0	0
20	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
21	2	7.1	0	0	0	0
21	3	1.2	1.2	0	0	0
21	4	4.2	4.2	0	0	0
21	5	3.9	3.9	0	0	0
21	6	12.0	12.0	0	0	0
21	7	8.9	0	0	0	0
21	8	6.0	0	0	0	0
21	9	15.2	.3	.3	.3	0
21	10	0	0	0	0	0
21	11	0	0	0	0	0
21	12	.6	0	0	0	0
21	13	0	0	0	0	0
21	14	5.7	0	0	0	0
21	15	.1	0	0	0	0
21	16	0	0	0	0	0
21	17	0	0	0	0	0
21	18	0	0	0	0	0
21	19	0	0	0	0	0
21	20	0	0	0	0	0
21	21	0	0	0	0	0
21	22	2.0	1.8	.9	0	0
21	23	2.2	1.2	.6	0	0
21	24	.6	.6	.3	0	0
21	25	0	0	0	0	0
21	26	0	0	0	0	0
21	27	0	0	0	0	0
21	28	0	0	0	0	0
21	29	0	0	0	0	0
21	30	0	0	0	0	0
21	31	.3	.3	.3	0	0
21	32	1.9	1.9	1.3	0	0
21	33	0	0	0	0	0
21	34	3.8	0	0	0	0
21	35	4.7	4.7	1.6	0	0
21	36	2.6	2.6	.9	0	0
21	37	1.6	1.6	.6	0	0
21	38	1.3	1.3	.7	0	0
21	39	.4	0	0	0	0
21	40	1.9	0	0	0	0
21	41	0	0	0	0	0
21	42	0	0	0	0	0
21	43	0	0	0	0	0
21	44	0	0	0	0	0
21	45	0	0	0	0	0
21	46	0	0	0	0	0
21	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
22	2	1.8	0	0	0	0
22	3	2.8	0	0	0	0
22	4	0	0	0	0	0
22	5	7.7	7.7	0	0	0
22	6	11.2	11.2	0	0	0
22	7	13.4	13.4	0	0	0
22	8	3.1	3.1	0	0	0
22	9	1.5	1.5	0	0	0
22	10	0	0	0	0	0
22	11	0	0	0	0	0
22	12	.6	0	0	0	0
22	13	0	0	0	0	0
22	14	1.3	0	0	0	0
22	15	.7	0	0	0	0
22	16	0	0	0	0	0
22	17	0	0	0	0	0
22	18	0	0	0	0	0
22	19	0	0	0	0	0
22	20	7.3	7.3		0	0
22	21	.6	0	0	0	0
22	22	0	0	0	0	0
22	23	0	0	0	0	0
22	24	0	0	0	0	0
22	25	0	0	0	0	0
22	26	0	0	0	0	0
22	27	0	0	0	0	0
22	28	0	0	0	0	0
22	29	0	0	0	0	0
22	30	0	0	0	.3	.3
22	31	.4	.4	0	0	0
22	32	0	0	0	0	0
22	33	0	0	0	0	0
22	34	0	0	0	0	0
22	35	6.2	6.2	0	0	0
22	36	2.8	2.8	0	0	0
22	37	1.3	1.3	0	0	0
22	38	.3	.3	0	0	0
22	39	0	0	0	0	0
22	40	0	0	0	0	0
22	41	0	0	0	0	0
22	42	0	0	0	0	0
22	43	0	0	0	0	0
22	44	0	0	0	0	0
22	45	0	0	0	0	0
22	46	0	0	0	0	0
22	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
23	3	0	0	0	0	0
23	4	0	0	0	0	0
23	5	7.7	7.7	0	0	0
23	6	14.3	14.3	0	0	0
23	7	8.3	8.3	0	0	0
23	8	0	0	0	0	0
23	9	4.5	4.5	0	0	0
23	10	9.9	9.9	0	0	0
23	11	0	0	0	0	0
23	12	0	0	0	0	0
23	13	0	0	0	0	0
23	14	0	0	0	0	0
23	15	0	0	0	0	0
23	16	0	0	0	0	0
23	17	0	0	0	0	0
23	18	0	0	0	0	0
23	19	0	0	0	0	0
23	20	12.3	12.3	0	0	0
23	21	4.3	4.3	0	0	0
23	22	4.3	4.3	0	0	0
23	23	1.6	1.6	0	0	0
23	24	10.0	10.0	0	0	0
23	25	0	0	0	0	0
23	26	0	0	0	0	0
23	27	0	0	0	0	0
23	28	0	0	0	0	0
23	29	0	0	0	0	0
23	30	0	0	0	0	0
23	31	.3	.3	.3	0	0
23	32	2.3	2.3	1.2	0	0
23	33	1.5	1.5	.6	0	0
23	34	.4	.4	.1	0	0
23	35	1.5	1.5	.9	0	0
23	36	1.2	1.2	.6	0	0
23	37	.4	.4	.4	0	0
23	38	.3	.3	1.8	.3	0
23	39	.7	.7	.7	1.2	0
23	40	0	0	0	0	0
23	41	0	0	0	0	0
23	42	.1	.1	.1	.1	0
23	43	0	0	0	0	0
23	44	0	0	0	0	0
23	45	1.0	1.0	.6	0	0
23	46	0	0	0	0	0
23	47	1.6	1.6	.9	0	0

Col.	Row	1972	1965	1958	1950	1943
24	4	0	0	0	0	0
24	5	10.6	10.6	0	0	0
24	6	12.0	12.0	0	0	0
24	7	0	0	0	0	0
24	8	0	0	0	0	0
24	9	6.0	6.0	0	0	0
24	10	0	0	0	0	0
24	11	0	0	0	0	0
24	12	0	0	0	0	0
24	13	0	0	0	0	0
24	14	0	0	0	0	0
24	15	0	0	0	0	0
24	16	0	0	0	0	0
24	17	0	0	0	0	0
24	18	0	0	0	0	0
24	19	0	0	0	0	0
24	20	14.2	14.2	0	0	0
24	21	7.6	7.6	0	0	0
24	22	10.9	10.9	0	0	0
24	23	10.0	10.0	0	0	0
24	24	14.0	14.0	0	0	0
24	25	0	0	0	0	0
24	26	0	0	0	0	0
24	27	0	0	0	0	0
24	28	0	0	0	0	0
24	29	0	0	0	0	0
24	30	0	0	0	0	0
24	31	0	0	0	0	0
24	32	2.0	2.0	1.0	0	0
24	33	1.2	1.2	.6	0	0
24	34	.1	.1	.1	0	0
24	35	.4	.4	.4	0	0
24	36	.4	.4	.4	0	0
24	37	.3	.3	.3	0	0
24	38	.6	.6	.6	.6	0
24	39	.4	.4	.4	.4	0
24	40	.1	.1	.1	0	0
24	41	0	0	0	0	0
24	42	.1	.1	.1	0	0
24	43	0	0	0	0	0
24	44	0	0	0	0	0
24	45	0	0	0	0	0
24	46	0	0	0	0	0
24	47	.3	.3	0	0	0

Col.	Row	1972	1965	1958	1950	1943
25	5	2.6	2.6	0	0	0
25	6	0	0	0	0	0
25	7	0	0	0	0	0
25	8	0	0	0	0	0
25	9	0	0	0	0	0
25	10	0	0	0	0	0
25	11	10.0	10.0	0	0	0
25	12	28.0	28.0	0	0	0
25	13	40.0	40.0	0	0	0
25	14	40.0	40.0	0	0	0
25	15	8.0	8.0	0	0	0
25	16	0	0	0	0	0
25	17	0	0	0	0	0
25	18	0	0	0	0	0
25	19	8.0	8.0	0	0	0
25	20	30.0	30.0	0	0	0
25	21	22.0	22.0	0	0	0
25	22	20.0	20.0	0	0	0
25	23	18.0	18.0	0	0	0
25	24	0	0	0	0	0
25	25	0	0	0	0	0
25	26	0	0	0	0	0
25	27	0	0	0	0	0
25	28	0	0	0	0	0
25	29	0	0	0	0	0
25	30	0	0	0	0	0
25	31	0	0	0	0	0
25	32	0	0	0	0	0
25	33	0	0	0	0	0
25	34	0	0	0	0	0
25	35	.6	.6	.6	0	0
25	36	.4	.4	.4	0	0
25	37	.3	.3	.3	0	0
25	38	2.8	2.8	1.2	0	0
25	39	.4	.4	.3	.3	0
25	40	1.0	1.0	.6	0	0
25	41	.6	.6	.3	0	0
25	42	.4	.4	.1	0	0
25	43	0	0	0	0	0
25	44	0	0	0	0	0
25	45	0	0	0	0	0
25	46	18.7	0	0	0	0
25	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
26	6	0	0	0	0	0
26	7	0	0	0	0	0
26	8	0	0	0	0	0
26	9	8.0	8.0	8.0	0	0
26	10	20.0	20.0	20.0	0	0
26	11	20.0	20.0	20.0	0	0
26	12	28.0	28.0	28.0	0	0
26	13	36.0	36.0	36.0	0	0
26	14	36.0	36.0	36.0	0	0
26	15	8.0	8.0	8.0	0	0
26	16	0	0	0	0	0
26	17	0	0	0	0	0
26	18	2.0	2.0	2.0	0	0
26	19	8.0	8.0	8.0	0	0
26	20	0	0	0	0	0
26	21	0	0	0	0	0
26	22	0	0	0	0	0
26	23	0	0	0	0	0
26	24	0	0	0	0	0
26	25	9.0	9.0	9.0	0	0
26	26	4.1	4.1	4.1	0	0
26	27	0	0	0	0	0
26	28	0	0	0	0	0
26	29	0	0	0	0	0
26	30	0	0	0	0	0
26	31	0	0	0	0	0
26	32	0	0	0	0	0
26	33	0	0	0	0	0
26	34	0	0	0	0	0
26	35	0	0	0	0	0
26	36	0	0	0	0	0
26	37	.4	.4	.3	0	0
26	38	.6	.6	.3	0	0
26	39	.3	.3	.3	.3	0
26	40	.4	.4	0	0	0
26	41	1.6	1.6	.9	0	0
26	42	.7	.7	.4	0	0
26	43	0	0	0	0	0
26	44	0	0	0	0	0
26	45	18.7	0	0	0	0
26	46	37.2	0	0	0	0
26	47	31.1	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
27	6	0	0	0	0	0
27	7	8.0	8.0	8.0	3.8	3.8
27	8	14.0	14.0	14.0	7.1	7.1
27	9	12.0	12.0	12.0	7.1	7.1
27	10	32.0	32.0	32.0	16.0	16.0
27	11	24.0	24.0	24.0	11.8	11.8
27	12	24.0	24.0	24.0	11.8	11.8
27	13	34.0	34.0	34.0	17.0	17.0
27	14	38.0	38.0	38.0	18.8	18.8
27	15	24.0	24.0	24.0	11.8	11.8
27	16	16.0	16.0	16.0	8.0	8.0
27	17	18.0	18.0	18.0	16.0	16.0
27	18	20.0	20.0	20.0	10.0	10.0
27	19	18.0	18.0	18.0	16.0	16.0
27	20	28.0	28.0	28.0	14.1	14.1
27	21	2.8	2.8	2.8	2.8	2.8
27	22	0	0	0	0	0
27	23	0	0	0	0	0
27	24	10.0	10.0	10.0	10.0	10.0
27	25	14.1	14.1	14.1	14.1	14.1
27	26	4.0	4.0	4.0	4.0	4.0
27	27	0	0	0	0	0
27	28	0	0	0	0	0
27	29	0	0	0	0	0
27	30	0	0	0	0	0
27	31	0	0	0	0	0
27	32	0	0	0	0	0
27	33	0	0	0	0	0
27	34	0	0	0	0	0
27	35	0	0	0	0	0
27	36	0	0	0	0	0
27	37	0	0	0	0	0
27	38	0	0	0	0	0
27	39	0	0	0	0	0
27	40	0	0	0	0	0
27	41	1.5	1.5	.7	0	0
27	42	1.8	0	0	0	0
27	43	0	0	0	0	0
27	44	0	0	0	0	0
27	45	0	0	0	0	0
27	46	43.5	0	0	0	0
27	47	62.1	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
28	6	0	0	0	0	0
28	7	16.0	16.0	16.0	16.0	16.0
28	8	28.0	28.0	28.0	28.0	28.0
28	9	16.0	16.0	16.0	16.0	16.0
28	10	36.0	36.0	36.0	36.0	36.0
28	11	36.0	36.0	36.0	36.0	36.0
28	12	24.0	24.0	24.0	24.0	24.0
28	13	32.0	32.0	32.0	32.0	32.0
28	14	40.0	40.0	40.0	40.0	40.0
28	15	34.0	34.0	34.0	34.0	34.0
28	16	26.0	26.0	26.0	26.0	26.0
28	17	0	0	0	0	0
28	18	20.0	20.0	20.0	20.0	20.0
28	19	30.0	30.0	30.0	30.0	30.0
28	20	36.0	36.0	36.0	36.0	36.0
28	21	3.2	3.2	3.2	3.2	3.2
28	22	0	0	0	0	0
28	23	0	0	0	0	0
28	24	24.0	24.0	24.0	24.0	24.0
28	25	16.0	16.0	16.0	16.0	16.0
28	26	.7	.7	0	0	0
28	27	0	0	0	0	0
28	28	0	0	0	0	0
28	29	0	0	0	0	0
28	30	0	0	0	0	0
28	31	0	0	0	0	0
28	32	0	0	0	0	0
28	33	0	0	0	0	0
28	34	0	0	0	0	0
28	35	0	0	0	0	0
28	36	0	0	0	0	0
28	37	0	0	0	0	0
28	38	0	0	0	0	0
28	39	0	0	0	0	0
28	40	2.2	0	0	0	0
28	41	1.9	0	0	0	0
28	42	1.8	0	0	0	0
28	43	.6	0	0	0	0
28	44	0	0	0	0	0
28	45	0	0	0	0	0
28	46	0	0	0	0	0
28	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
29	7	10.0	10.0	10.0	0	0
29	8	0	0	0	0	0
29	9	30.0	30.0	30.0	30.0	30.0
29	10	36.0	36.0	36.0	36.0	36.0
29	11	36.0	36.0	36.0	36.0	36.0
29	12	40.0	40.0	40.0	40.0	40.0
29	13	40.0	40.0	40.0	40.0	40.0
29	14	36.0	36.0	36.0	36.0	36.0
29	15	2.0	2.0	2.0	2.0	2.0
29	16	.2	.2	.2	.2	.2
29	17	0	0	0	0	0
29	18	20.0	20.0	20.0	20.0	20.0
29	19	30.0	30.0	30.0	30.0	30.0
29	20	30.0	30.0	30.0	30.0	30.0
29	21	12.0	12.0	12.0	12.0	12.0
29	22	0	0	0	0	0
29	23	0	0	0	0	0
29	24	20.0	20.0	20.0	20.0	20.0
29	25	20.0	20.0	20.0	20.0	20.0
29	26	1.6	1.6	1.6	0	0
29	27	2.5	2.5	2.5	0	0
29	28	2.0	2.0	2.0	0	0
29	29	0	0	0	0	0
29	30	0	0	0	0	0
29	31	0	0	0	0	0
29	32	0	0	0	0	0
29	33	0	0	0	0	0
29	34	0	0	0	0	0
29	35	0	0	0	0	0
29	36	0	0	0	0	0
29	37	0	0	0	0	0
29	38	1.0	1.0	0	0	0
29	39	0	0	0	0	0
29	40	2.3	0	0	0	0
29	41	2.3	0	0	0	0
29	42	2.3	0	0	0	0
29	43	1.3	0	0	0	0
29	44	0	0	0	0	0
29	45	0	0	0	0	0
29	46	0	0	0	0	0
29	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
30	8	0	0	0	0	0
30	9	0	0	0	0	0
30	10	10.0	10.0	10.0	10.0	10.0
30	11	10.0	10.0	10.0	10.0	10.0
30	12	10.0	10.0	10.0	10.0	10.0
30	13	10.0	10.0	10.0	10.0	10.0
30	14	10.0	10.0	10.0	10.0	10.0
30	15	10.0	10.0	10.0	10.0	10.0
30	16	30.0	30.0	30.0	30.0	30.0
30	17	30.0	30.0	30.0	30.0	30.0
30	18	5.0	5.0	5.0	5.0	5.0
30	19	7.0	7.0	7.0	6.8	6.8
30	20	10.0	10.0	10.0	10.0	10.0
30	21	0	0	0	0	0
30	22	0	0	0	0	0
30	23	12.0	12.0	12.0	12.0	12.0
30	24	30.0	30.0	30.0	30.0	30.0
30	25	18.0	18.0	18.0	18.0	18.0
30	26	1.2	1.2	1.2	0	0
30	27	.6	.6	.6	0	0
30	28	.6	.6	.6	0	0
30	29	0	0	0	0	0
30	30	0	0	0	0	0
30	31	0	0	0	0	0
30	32	0	0	0	0	0
30	33	0	0	0	0	0
30	34	0	0	0	0	0
30	35	0	0	0	0	0
30	36	0	0	0	0	0
30	37	0	0	0	0	0
30	38	0	0	0	0	0
30	39	0	0	0	0	0
30	40	0	0	0	0	0
30	41	2.3	0	0	0	0
30	42	2.3	0	0	0	0
30	43	2.3	0	0	0	0
30	44	0	0	0	0	0
30	45	0	0	0	0	0
30	46	0	0	0	0	0
30	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
31	9	0	0	0	0	0
31	10	0	0	0	0	0
31	11	0	0	0	0	0
31	12	0	0	0	0	0
31	13	0	0	0	0	0
31	14	0	0	0	0	0
31	15	0	0	0	0	0
31	16	0	0	0	0	0
31	17	0	0	0	0	0
31	18	0	0	0	0	0
31	19	0	0	0	0	0
31	20	0	0	0	0	0
31	21	0	0	0	0	0
31	22	0	0	0	0	0
31	23	0	0	0	0	0
31	24	0	0	0	0	0
31	25	1.0	0	0	0	0
31	26	1.0	1.0	0	0	0
31	27	2.6	2.6	0	0	0
31	28	2.6	2.6	0	0	0
31	29	0	0	0	0	0
31	30	0	0	0	0	0
31	31	0	0	0	0	0
31	32	0	0	0	0	0
31	33	0	0	0	0	0
31	34	0	0	0	0	0
31	35	0	0	0	0	0
31	36	0	0	0	0	0
31	37	0	0	0	0	0
31	38	0	0	0	0	0
31	39	0	0	0	0	0
31	40	.4	0	0	0	0
31	41	.3	0	0	0	0
31	42	0	0	0	0	0
31	43	2.3	0	0	0	0
31	44	0	0	0	0	0
31	45	0	0	0	0	0
31	46	0	0	0	0	0
31	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
32	10	0	0	0	0	0
32	11	0	0	0	0	0
32	12	0	0	0	0	0
32	13	0	0	0	0	0
32	14	16.0	16.0	16.0	0	0
32	15	16.0	16.0	16.0	0	0
32	16	0	0	0	0	0
32	17	0	0	0	0	0
32	18	0	0	0	0	0
32	19	0	0	0	0	0
32	20	0	0	0	0	0
32	21	0	0	0	0	0
32	22	0	0	0	0	0
32	23	0	0	0	0	0
32	24	0	0	0	0	0
32	25	.9	0	0	0	0
32	26	0	0	0	0	0
32	27	.3	.3	0	0	0
32	28	1.6	1.6	0	0	0
32	29	0	0	0	0	0
32	30	0	0	0	0	0
32	31	0	0	0	0	0
32	32	0	0	0	0	0
32	33	0	0	0	0	0
32	34	0	0	0	0	0
32	35	0	0	0	0	0
32	36	0	0	0	0	0
32	37	0	0	0	0	0
32	38	0	0	0	0	0
32	39	0	0	0	0	0
32	40	0	0	0	0	0
32	41	0	0	0	0	0
32	42	0	0	0	0	0
32	43	0	0	0	0	0
32	44	0	0	0	0	0
32	45	0	0	0	0	0
32	46	0	0	0	0	0
32	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
33	10	0	0	0	0	0
33	11	0	0	0	0	0
33	12	0	0	0	0	0
33	13	0	0	0	0	0
33	14	0	0	0	0	0
33	15	0	0	0	0	0
33	16	0	0	0	0	0
33	17	0	0	0	0	0
33	18	0	0	0	0	0
33	19	0	0	0	0	0
33	20	0	0	0	0	0
33	21	0	0	0	0	0
33	22	0	0	0	0	0
33	23	0	0	0	0	0
33	24	0	0	0	0	0
33	25	0	0	0	0	0
33	26	0	0	0	0	0
33	27	0	0	0	0	0
33	28	0	0	0	0	0
33	29	0	0	0	0	0
33	30	.6	0	0	0	0
33	31	0	0	0	0	0
33	32	0	0	0	0	0
33	33	0	0	0	0	0
33	34	0	0	0	0	0
33	35	0	0	0	0	0
33	36	0	0	0	0	0
33	37	0	0	0	0	0
33	38	0	0	0	0	0
33	39	0	0	0	0	0
33	40	0	0	0	0	0
33	41	0	0	0	0	0
33	42	0	0	0	0	0
33	43	0	0	0	0	0
33	44	0	0	0	0	0
33	45	0	0	0	0	0
33	46	0	0	0	0	0
33	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
34	10	0	0	0	0	0
34	11	0	0	0	0	0
34	12	0	0	0	0	0
34	13	0	0	0	0	0
34	14	0	0	0	0	0
34	15	0	0	0	0	0
34	16	0	0	0	0	0
34	17	0	0	0	0	0
34	18	0	0	0	0	0
34	19	0	0	0	0	0
34	20	0	0	0	0	0
34	21	0	0	0	0	0
34	22	0	0	0	0	0
34	23	0	0	0	0	0
34	24	0	0	0	0	0
34	25	0	0	0	0	0
34	26	0	0	0	0	0
34	27	0	0	0	0	0
34	28	0	0	0	0	0
34	29	0	0	0	0	0
34	30	0	0	0	0	0
34	31	0	0	0	0	0
34	32	0	0	0	0	0
34	33	0	0	0	0	0
34	34	0	0	0	0	0
34	35	0	0	0	0	0
34	36	0	0	0	0	0
34	37	0	0	0	0	0
34	38	0	0	0	0	0
34	39	0	0	0	0	0
34	40	0	0	0	0	0
34	41	0	0	0	0	0
34	42	0	0	0	0	0
34	43	0	0	0	0	0
34	44	0	0	0	0	0
34	45	0	0	0	0	0
34	46	0	0	0	0	0
34	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
35	10	0	0	0	0	0
35	11	0	0	0	0	0
35	12	0	0	0	0	0
35	13	0	0	0	0	0
35	14	0	0	0	0	0
35	15	0	0	0	0	0
35	16	0	0	0	0	0
35	17	0	0	0	0	0
35	18	0	0	0	0	0
35	19	0	0	0	0	0
35	20	0	0	0	0	0
35	21	0	0	0	0	0
35	22	0	0	0	0	0
35	23	0	0	0	0	0
35	24	0	0	0	0	0
35	25	0	0	0	0	0
35	26	0	0	0	0	0
35	27	0	0	0	0	0
35	28	0	0	0	0	0
35	29	0	0	0	0	0
35	30	0	0	0	0	0
35	31	.9	.9	0	0	0
35	32	0	0	0	0	0
35	33	0	0	0	0	0
35	34	0	0	0	0	0
35	35	0	0	0	0	0
35	36	0	0	0	0	0
35	37	0	0	0	0	0
35	38	0	0	0	0	0
35	39	0	0	0	0	0
35	40	0	0	0	0	0
35	41	0		0	0	0
35	42	0	0	0	0	0
35	43	0	0	0	0	0
35	44	0	0	0	0	0
35	45	0	0	0	0	0
35	46	0	0	0	0	0
35	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
36	9	0	0	0	0	0
36	10	0	0	0	0	0
36	11	0	0	0	0	0
36	12	0	0	0	0	0
36	13	0	0	0	0	0
36	14	0	0	0	0	0
36	15	0	0	0	0	0
36	16	0	0	0	0	0
36	17	0	0	0	0	0
36	18	0	0	0	0	0
36	19	0	0	0	0	0
36	20	0	0	0	0	0
36	21	0	0	0	0	0
36	22	0	0	0	0	0
36	23	0	0	0	0	0
36	24	0	0	0	0	0
36	25	0	0	0	0	0
36	26	0	0	0	0	0
36	27	0	0	0	0	0
36	28	0	0	0	0	0
36	29	0	0	0	0	0
36	30	0	0	0	0	0
36	31	0	0	0	0	0
36	32	0	0	0	0	0
36	33	0	0	0	0	0
36	34	0	0	0	0	0
36	35	0	0	0	0	0
36	36	0	0	0	0	0
36	37	0	0	0	0	0
36	38	0	0	0	0	0
36	39	0	0	0	0	0
36	40	0	0	0	0	0
36	41	0	0	0	0	0
36	42	0	0	0	0	0
36	43	0	0	0	0	0
36	44	0	0	0	0	0
36	45	0	0	0	0	0
36	46	0	0	0	0	0
36	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
37	9	0	0	0	0	0
37	10	0	0	0	0	0
37	11	0	0	0	0	0
37	12	0	0	0	0	0
37	13	0	0	0	0	0
37	14	0	0	0	0	0
37	15	0	0	0	0	0
37	16	0	0	0	0	0
37	17	0	0	0	0	0
37	18	0	0	0	0	0
37	19	0	0	0	0	0
37	20	0	0	0	0	0
37	21	0	0	0	0	0
37	22	0	0	0	0	0
37	23	0	0	0	0	0
37	24	0	0	0	0	0
37	25	0	0	0	0	0
37	26	0	0	0	0	0
37	27	0	0	0	0	0
37	28	0	0	0	0	0
37	29	0	0	0	0	0
37	30	0	0	0	0	0
37	31	0	0	0	0	0
37	32	0	0	0	0	0
37	33	0	0	0	0	0
37	34	0	0	0	0	0
37	35	0	0	0	0	0
37	36	0	0	0	0	0
37	37	0	0	0	0	0
37	38	0	0	0	0	0
37	39	0	0	0	0	0
37	40	0	0	0	0	0
37	41	0	0	0	0	0
37	42	0	0	0	0	0
37	43	0	0	0	0	0
37	44	0	0	0	0	0
37	45	0	0	0	0	0
37	46	0	0	0	0	0
37	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
38	8	0	0	0	0	0
38	9	0	0	0	0	0
38	10	0	0	0	0	0
38	11	0	0	0	0	0
38	12	0	0	0	0	0
38	13	0	0	0	0	0
38	14	0	0	0	0	0
38	15	0	0	0	0	0
38	16	0	0	0	0	0
38	17	0	0	0	0	0
38	18	0	0	0	0	0
38	19	0	0	0	0	0
38	20	0	0	0	0	0
38	21	0	0	0	0	0
38	22	0	0	0	0	0
38	23	0	0	0	0	0
38	24	0	0	0	0	0
38	25	0	0	0	0	0
38	26	0	0	0	0	0
38	27	0	0	0	0	0
38	28	0	0	0	0	0
38	29	0	0	0	0	0
38	30	0	0	0	0	0
38	31					
38	32					
38	33	0	0	0	0	0
38	34	0	0	0	0	0
38	35	0	0	0	0	0
38	36	0	0	0	0	0
38	37	0	0	0	0	0
38	38	0	0	0	0	0
38	39	0	0	0	0	0
38	40	0	0	0	0	0
38	41	0	0	0	0	0
38	42	0	0	0	0	0
38	43	0	0	0	0	0
38	44	0	0	0	0	0
38	45	0	0	0	0	0
38	46	0	0	0	0	0
38	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
39	8	0	0	0	0	0
39	9	0	0	0	0	0
39	10	0	0	0	0	0
39	11	0	0	0	0	0
39	12	0	0	0	0	0
39	13	0	0	0	0	0
39	14	0	0	0	0	0
39	15	0	0	0	0	0
39	16	0	0	0	0	0
39	17	0	0	0	0	0
39	18	0	0	0	0	0
39	19	0	0	0	0	0
39	20	0	0	0	0	0
39	21	0	0	0	0	0
39	22	0	0	0	0	0
39	23	0	0	0	0	0
39	24	0	0	0	0	0
39	25	0	0	0	0	0
39	26	0	0	0	0	0
39	27	0	0	0	0	0
39	28					
39	29					
39	30					
39	31					
39	32					
39	33					
39	34					
39	35					
39	36					
39	37					
39	38					
39	39	0	0	0	0	0
39	40	0	0	0	0	0
39	41	0	0	0	0	0
39	42	0	0	0	0	0
39	43	0	0	0	0	0
39	44	0	0	0	0	0
39	45	0	0	0	0	0
39	46	0	0	0	0	0
39	47	0	0	0	0	0

Col.	Row	1972	1965	1958	1950	1943
40	7	0	0	0	0	0
40	8	0	0	0	0	0
40	9	0	0	0	0	0
40	10	0	0	0	0	0
40	11	0	0	0	0	0
40	12	0	0	0	0	0
40	13	0	0	0	0	0
40	14	0	0	0	0	0
40	15	0	0	0	0	0
40	16	0	0	0	0	0
40	17	0	0	0	0	0
40	18	0	0	0	0	0
40	19	0	0	0	0	0
40	20	0	0	0	0	0
40	21	0	0	0	0	0
40	22	0	0	0	0	0
40	23	0	0	0	0	0
40	24	0	0	0	0	0
40	25	0	0	0	0	0
40	26	0	0	0	0	0
40	27					
40	28					
40	29					
40	30					
40	31					
40	32					
40	33					
40	34					
40	35					
40	36					
40	37					
40	38					
40	39					
40	40	0	0	0	0	0
40	41	0	0	0	0	0
40	42	0	0	0	0	0
40	43	0	0	0	0	0
40	44	0	0	0	0	0
40	45	0	0	0	0	0
40	46	0	0	0	0	0
40	47	0	0	0	0	0

Part 4. Northwest Subarea - Discharge by pumpage of private wells (1972 only). (private well pumpage based on 2 acre feet per year of 1.24 gal/min per dwelling unit)

Col.	Row	Dwelling units	gal/min
2	5	1	1.2
2	6	1	1.2
4	1	1	1.2
6	1	1	1.2
6	2	1	1.2
6	3	1	1.2
7	1	1	1.2
7	2	4	4.9
7	3	2	2.4
7	4	1	1.2
7	6	1	1.2
8	1	1	1.2
8	2	1	1.2
8	3	10	12.4
8	4	1	1.2
8	5	5	6.2
8	6	4	4.9
8	7	2	2.4
9	3	5	6.2
9	6	4	4.9
9	7	3	3.7
10	1	2	2.4
10	3	3	3.7
4	17	2	2.4
8	16	4	4.9
8	17	5	6.2
8	19	3	3.7
9	16	6	7.4
9	17	9	11.1
9	18	19	23.5
9	19	10	12.4
9	20	12	7.4
9	21	17	21.0
9	22	9	11.1
10	18	5	6.2
10	19	4	4.9
10	20	17	21.0
10	21	30	37.1
10	22	29	35.8
11	17	3	3.1
11	18	7	8.7
11	19	2	2.4
11	20	25	30.9
11	21	25	30.9
11	22	21	26.0
4	28	1	1.2
6	28	1	1.2
7	24	9	11.1
7	27	1	1.2
8	24	11	13.6
8	25	19	23.5
9	24	10	12.4

Col.	Row	Dwelling units	gal/min
9	25	7	8.7
10	23	8	9.9
10	24	4	4.9
11	23	25	30.9
11	24	4	4.9
11	25	4	4.9
14	4	4	4.9
14	5	19	23.5
14	6	9	11.1
15	4	2	2.4
15	5	11	13.6
15	6	4	4.9
16	5	2	2.4
19	7	2	2.4
12	17	1	1.2
12	18	2	2.4
12	19	2	2.4
12	20	8	9.9
12	21	15	18.5
12	22	9	11.1
16	17	22	27.2
16	18	45	55.6
16	19	26	32.1
17	17	8	9.9
17	18	16	19.8
18	17	6	7.4
18	18	8	9.9
18	19	9	11.7
18	20	6	7.4
19	19	6	7.4
19	20	7	8.9
20	26	4	4.9
23	7	18	22.3
23	8	8	9.9
24	7	12	14.8
24	8	10	12.4
24	9	20	24.7
25	9	3	3.7
22	14	6	7.4
23	14	10	12.4
23	15	2	2.4
26	16	17	21.0
26	20	16	19.8
26	21	32	39.6
26	22	41	50.7
27	20	18	22.3
27	22	38	47.0
28	20	15	18.5
28	21	15	18.5
28	22	11	13.6
25	26	2	2.4
26	24	2	2.4
27	25	8	9.9
28	25	10	12.4
29	26	1	1.2
30	26	1	1.2
30	27	2	2.4

Part 5. Southwest Subarea - Discharge by pumpage of private wells (1972 only). (private well pumpage based on 2 acre feet per year or 1.24 gal/min per dwelling unit)

Col.	Row	Dwelling units	gal/min
1	5	5	6.2
1	10	3	3.7
2	2	4	4.9
2	10	4	4.9
2	11	1	1.2
3	6	1	1.2
3	10	1	1.2
4	2	1	1.2
4	3	3	3.7
4	6	1	1.2
4	11	1	1.2
5	11	2	2.4
6	1	2	2.4
6	2	4	4.9
6	6	1	1.2
6	7	2	2.4
6	8	1	1.2
6	17	2	2.4
6	18	2	2.4
6	19	3	3.7
7	1	2	2.4
7	2	1	1.2
7	3	3	3.7
7	4	3	3.7
7	19	6	7.4
7	20	1	1.2
8	1	4	4.9
8	2	4	4.9
8	6	2	2.4
8	7	1	1.2
8	19	4	4.9
9	1	4	4.9
9	2	1	1.2
9	3	1	1.2
9	8	1	1.2
10	1	4	4.9
10	2	1	1.2
10	3	1	1.2
11	1	2	2.4
11	2	1	1.2
11	3	3	3.7
12	3	2	2.4
12	7	2	2.4
12	8	1	1.2
12	9	5	6.2
13	6	3	3.7
13	9	1	1.2
13	16	8	9.9
13	17	2	2.4
13	19	7	8.7

Col.	Row	Dwelling units	gal/min
13	20	3	3.7
14	6	3	3.7
14	11	1	1.2
14	14	9	11.1
14	15	3	3.7
15	2	2	2.4
15	5	1	1.2
15	9	1	1.2
15	15	15	18.5
15	16	8	9.9
16	3	3	3.7
16	4	1	1.2
16	7	3	3.7
16	10	8	9.9
16	11	3	3.7
16	14	2	2.4
16	15	1	1.2
16	16	1	1.2
16	17	1	1.2
16	20	4	4.9
16	21	4	4.9
17	4	3	3.7
17	9	14	17.3
17	10	8	9.9
17	11	2	2.4
17	15	1	1.2
17	16	1	1.2
17	20	6	7.4
18	9	9	11.1
18	10	3	3.7
18	11	1	1.2
18	14	1	1.2
18	15	3	3.7
18	16	3	3.7
18	17	2	2.4
18	20	3	3.7
19	3	1	1.2
19	4	1	1.2
19	8	4	4.9
19	9	7	8.7
19	10	3	3.7
19	11	1	1.2
19	14	5	6.2
19	15	6	7.4
19	19	2	2.4
19	20	2	2.4
19	21	3	3.7
20	6	4	4.9
20	8	1	1.2
20	9	6	7.4
20	10	6	7.4
20	14	1	1.2
20	15	1	1.2
20	21	6	7.4

Col.	Row	Dwelling units	gal/min
21	5	2	2.4
21	8	2	2.4
21	9	3	3.7
21	10	2	2.4
21	19	4	4.9
21	20	2	2.4
21	21	4	4.9
22	5	4	4.9
22	24	2	2.4
22	25	1	1.2
22	27	1	1.2
22	28	6	7.4
22	29	2	2.4
22	30	3	3.7
22	31	4	4.9
23	5	2	2.4
23	6	5	6.2
23	27	1	1.2
23	28	3	3.7
23	29	3	3.7
23	30	1	1.2
23	31	3	3.7
24	13	3	3.7
24	14	1	1.2
24	14	1	1.2
24	16	1	1.2
24	20	2	2.4
24	26	2	2.4
24	28	5	6.2
24	29	2	2.4
24	31	3	3.7
25	6	7	8.7
25	7	6	7.4
25	8	4	4.9
25	12	2	2.4
25	14	2	2.4
25	17	2	2.4
25	28	2	2.4
25	31	5	6.2
26	8	4	6.2
26	9	8	9.9
26	10	1	1.2
26	13	1	1.2
26	14	4	4.9
26	16	2	2.4
26	17	5	6.2
26	25	7	8.7
26	27	1	1.2
26	28	3	3.7
27	9	7	8.7
27	10	7	8.7
27	14	1	1.2
27	15	10	[illegible]
27	16	5	6.2

Col.	Row	Dwelling units	gal/min
27	19	6	7.4
27	21	2	2.4
27	24	4	4.9
27	26	1	1.2
27	27	5	6.2
27	28	2	2.4
28	12	2	2.4
28	14	4	4.9
28	15	4	4.9
28	16	4	4.9
28	17	1	1.2
28	20	3	3.7
28	21	1	1.2
28	22	3	3.7
28	23	2	2.4
28	27	3	3.7
28	28	3	3.7
29	10	3	3.7
29	11	1	1.2
29	15	1	1.2
29	16	4	4.9
29	17	4	4.9
29	18	2	2.4
30	11	1	1.2
30	16	7	8.7
30	17	2	2.4
31	11	5	6.2
31	12	5	6.2
31	13	6	7.4
31	15	5	6.2
31	16	5	6.2
31	17	3	3.7
32	9	1	1.2
32	16	2	2.4
33	9	2	2.4
34	16	6	7.4
34	17	2	2.4
35	17	1	1.2

Part 6. Northeast subarea - Discharge by pumpage of private wells (1972 only). (private well pumpage based on 2 acre feet per year of 1.24 gal/min per dwelling unit)

Col.	Row	Dwelling units	gal/min
8	15	1	1.2
8	16	1	1.2
12	41	4	5.0
12	45	3	3.7
13	41	8	10.0
14	15	3	3.7
14	40	8	10.0
15	12	4	5.0
15	14	8	10.0
15	15	5	6.2
15	35	4	5.0
15	36	4	5.0
15	40	8	10.0
15	41	5	6.2
15	42	12	14.9
15	44	8	10.0
16	36	6	7.4
16	39	6	7.4
16	40	5	6.2
16	41	2	2.5
16	42	4	5.0
16	43	3	3.7
16	44	3	3.7
17	6	1	1.2
17	7	1	1.2
17	23	1	1.2
17	43	1	1.2
18	3	5	6.2
18	4	2	2.5
18	14	2	2.5
18	21	4	5.0
19	3	5	6.2
19	4	5	6.2
19	22	2	2.5
19	23	3	3.7
19	5	5	6.2
20	15	6	7.4
20	16	10	12.4
20	17	4	5.0
20	22	8	10.0
20	36	12	14.9
20	37	2	2.5
20	40	7	8.7
20	41	1	1.2
20	42	1	1.2
21	22	7	8.7
21	23	8	10.0
21	24	2	2.5

1972

Col.	Row	Dwelling units	gal/min
21	32	5	6.2
21	35	12	14.9
21	36	10	12.4
21	37	4	5.0
21	38	4	5.0
21	39	1	1.2
21	40	6	7.4
22	15	2	2.5
22	21	1	1.2
22	35	17	21.1
22	36	7	8.7
22	37	3	3.7
23	45	3	3.7
23	47	5	6.2
24	47	1	1.2
26	26	1	1.2
28	26	2	2.5
29	26	5	6.2
29	27	9	11.2
29	28	7	8.7
29	38	3	3.7
30	26	4	5.0
30	27	2	2.5
30	28	2	2.5
31	25	4	5.0
31	26	3	3.7
31	27	8	10.0
31	28	8	10.0
32	25	2	2.5
32	27	1	1.2
32	28	4	5.0
33	30	1	1.2
34	36	2	2.5
35	31	2	2.5

AREA #3

Pumpage from Private Wells
Trailers

Col.	Row	gal/min
11	20	22.0
10	24	9.7
13	18	59.5
13	46	4.7
14	17	9.3
15	16	8.4
15	39	3.0
15	37	23.7
15	38	24.7
11	45	26.1
11	47	5.6
12	46	26.2
12	47	13.1
18	39	16.5
19	39	14.9
22	47	19.8
25	18	3.1
23	36	9.9
23	35	1.6
27	26	148.8
28	26	118.7
30	27	8.7

Part 7. Northeast Subarea - Discharge through consumptive use by phreatophytes (1972 only). (Phreatophyte consumption based on 3.3 acre feet per acre per year)

Col.	Row	Acres	Acre ft per yr	1972 Consumptive use in gal/min
17	21	11.5	38.0	23.6
17	24	11.5	38.0	23.6
17	25	2.3	7.6	4.7
18	24	9.2	30.4	18.8
18	34	4.6	15.2	9.4
18	35	4.6	15.2	9.4
19	32	4.6	15.2	9.4
19	33	4.6	15.2	9.4
20	24	6.9	22.8	14.1
20	25	2.3	7.6	4.7
20	28	2.3	7.6	4.7
20	29	6.9	22.8	14.1
20	30	4.6	15.2	9.4
21	24	6.9	22.8	14.1
21	26	2.3	7.6	4.7
21	27	2.3	7.6	4.7
22	24	2.3	7.6	4.7
22	25	2.3	7.6	4.7
23	25	4.6	15.2	9.4
23	26	2.3	7.6	4.7
23	27	2.3	7.6	4.7
24	10	6.9	22.8	14.1
24	11	6.9	22.8	14.1
24	26	4.6	15.2	9.4
25	10	6.9	22.8	14.1
25	11	6.9	22.8	14.1
25	15	4.6	15.2	9.4
25	16	11.5	38.0	23.6
25	17	11.5	38.0	23.6
25	18	11.5	38.0	23.6
25	19	4.6	15.2	9.4
25	20	4.6	15.2	9.4
25	21	23.0	75.9	47.1
25	22	23.0	75.9	47.1
25	23	23.0	75.9	47.1
25	24	11.5	38.0	23.6
26	15	11.4	38.0	23.6
26	16	23.0	75.9	47.1
26	17	23.0	75.9	47.1
26	18	23.0	75.9	47.1
26	19	11.5	38.0	23.6
26	20	11.5	38.0	23.6
26	21	23.0	75.9	47.1
26	22	23.0	75.9	47.1
26	23	23.0	75.9	47.1
26	24	11.5	38.0	23.6
27	15	11.5	38.0	23.6
27	16	23.0	75.9	47.1
27	17	23.0	75.9	47.1
27	18	11.5	38.0	23.6

Col.	Row	Acres	Acre ft per yr	1972 Consumptive use in gal/min
26	19	11.5	38.0	23.6
26	20	11.5	38.0	23.6
26	21	23.0	75.9	47.1
26	22	23.0	75.9	47.1
26	23	23.0	75.9	47.1
26	24	11.5	38.0	23.6
27	15	11.5	38.0	23.6
27	16	23.0	75.9	47.1
27	17	23.0	75.9	47.1
27	18	11.5	38.0	23.6
27	19	4.6	15.2	9.4
27	20	4.6	15.2	9.4
27	21	4.6	15.2	9.4
27	22	23.0	75.9	47.1
27	23	11.4	38.0	23.6
27	24	4.6	15.2	9.4
27	30	2.3	7.6	4.7
27	33	4.6	15.2	9.4
27	34	4.6	15.2	9.4
27	35	4.6	15.2	9.4
28	21	4.6	15.2	9.4
28	22	23.0	75.9	47.1
28	23	11.5	38.0	23.6
28	33	4.6	15.2	9.4
29	21	11.5	38.0	23.6
29	22	23.0	75.9	47.1
29	23	11.5	38.0	23.6
30	21	4.6	15.2	9.4
30	22	11.5	38.0	23.6
30	23	4.6	15.2	9.4
31	10	6.9	22.8	14.1
31	11	23.0	75.9	47.1
31	12	23.0	75.9	47.1
31	13	23.0	75.9	47.1
31	14	23.0	75.9	47.1
31	15	9.2	30.4	18.8
32	10	11.5	38.0	23.6
32	11	23.0	75.9	47.1
32	12	18.4	60.7	37.6
32	13	11.5	38.0	23.6
32	14	2.3	7.6	4.7
33	10	4.6	15.2	9.4